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Bruce et al.

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(54) **METHOD AND SYSTEM FOR PROVIDING QUICK DIRECTIONS**

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(52) **U.S. Cl.** **379/88.17**; 379/72; 379/88.18; 379/88.19; 379/88.23; 379/201.08; 379/207.12

(58) **Field of Search** 379/88.01, 201, 379/207, 211, 216, 220, 229, 230, 246, 88.1, 71, 72, 76, 88.16, 88.17, 88.18, 88.19, 88.2, 88.23, 201.06, 201.07, 201.08, 207.12; 455/406, 456, 461; 700/209, 201, 208, 211, 212

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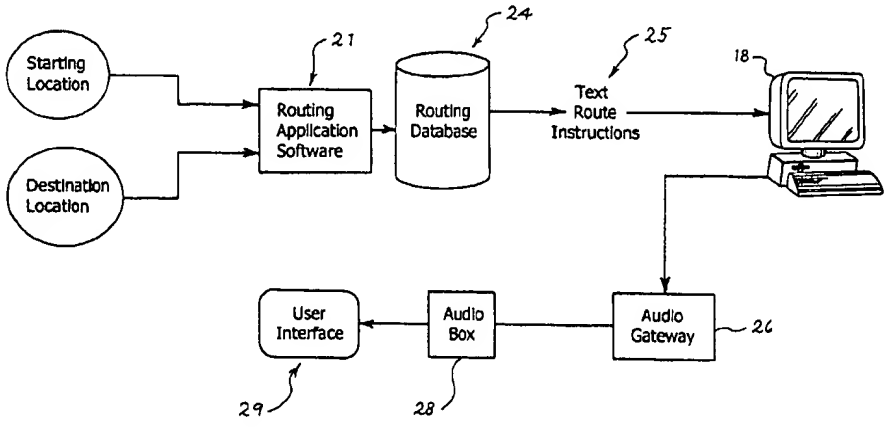
(57) **ABSTRACT**

A method and system for providing a telephone caller information assistance such as driving directions from a starting location to a destination location. To obtain information assistance, the caller places a telephone call to access the system. If the geographical location of the caller can be determined by an automatic location identification system it is displayed on an operator console where the caller's request is transferred to be handled by a live operator. The operator receives the caller's destination request and queries the system for the street route driving instructions to the requested destination. After obtaining the street route driving instructions, the call can be transferred to an audio box having an interactive user interface capable of replaying the desired information to the caller. In an illustrative embodiment, the interactive user interface is capable providing functions to stop, start, pause, and replay the information to the caller.

21 Claims, 18 Drawing Sheets



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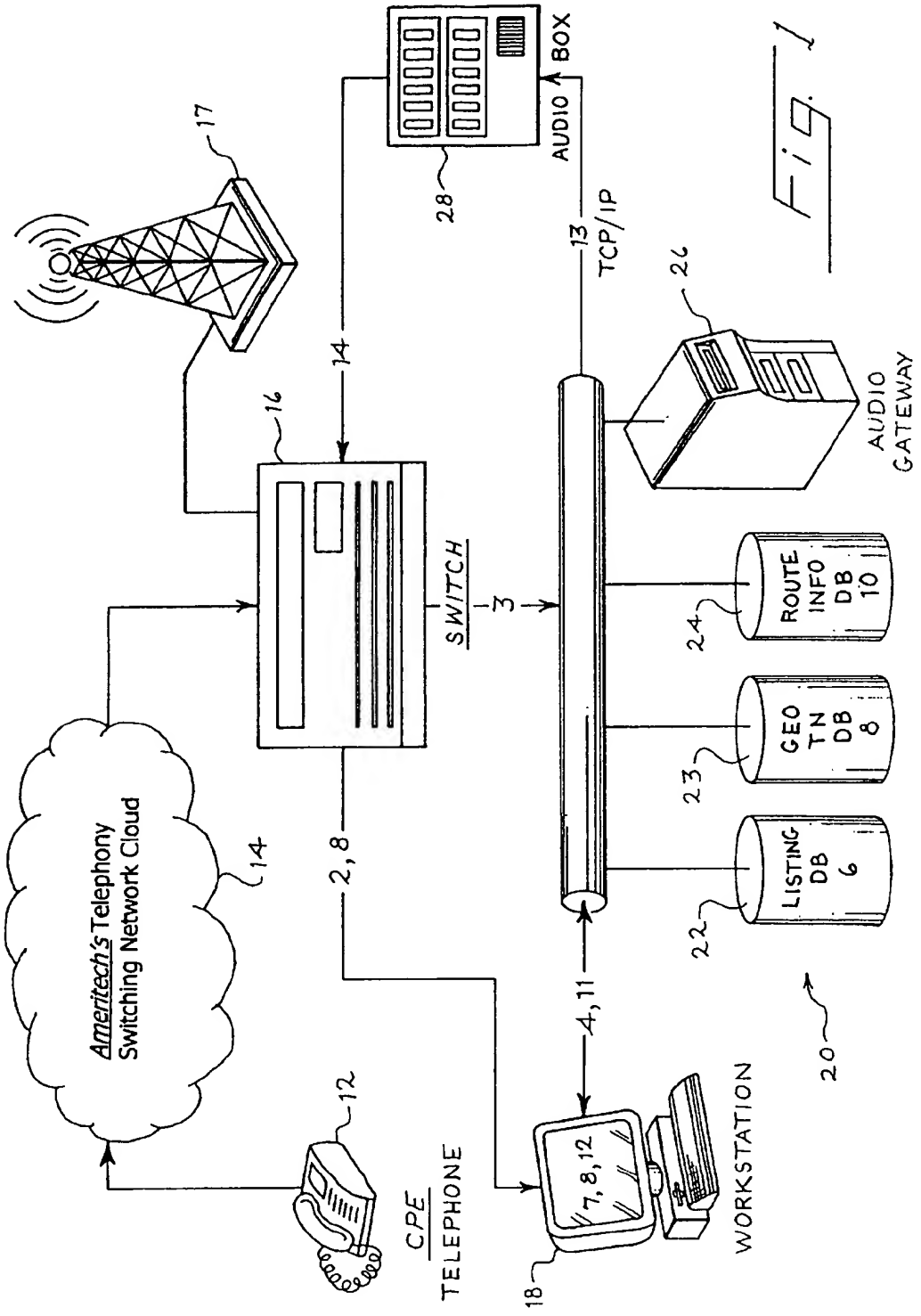

AUDIO BOX
28
17
13
TCP/IP
26
AUDIO GATEWAY
14
16
SWITCH
3
ROUTE INFO DB 10
24
GEO TN DB 8
23
LISTING DB 6
22
Ameritech's Telephony Switching Network Cloud
14
2, 8
4, 11
20
12
CPE TELEPHONE
7, 8, 12
18
WORKSTATION

Fig. 1

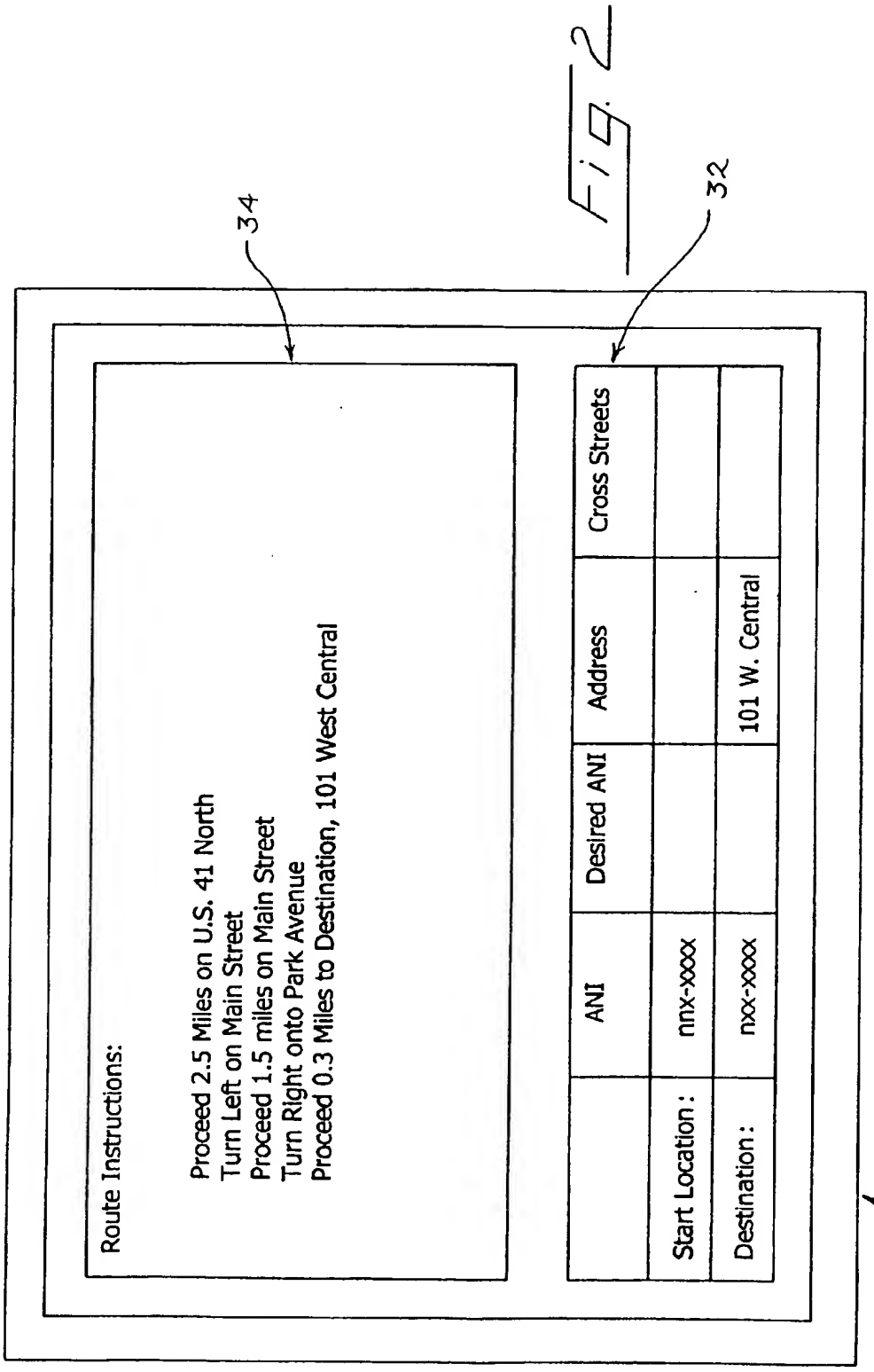

Route Instructions:
Proceed 2.5 Miles on U.S. 41 North
Turn Left on Main Street
Proceed 1.5 miles on Main Street
Turn Right onto Park Avenue
Proceed 0.3 Miles to Destination, 101 West Central
34
32
18
ANI
Desired ANI
Address
Cross Streets
Start Location:
nnx-xxxx
Destination:
nxx-xxxx
101 W. Central

Fig. 2

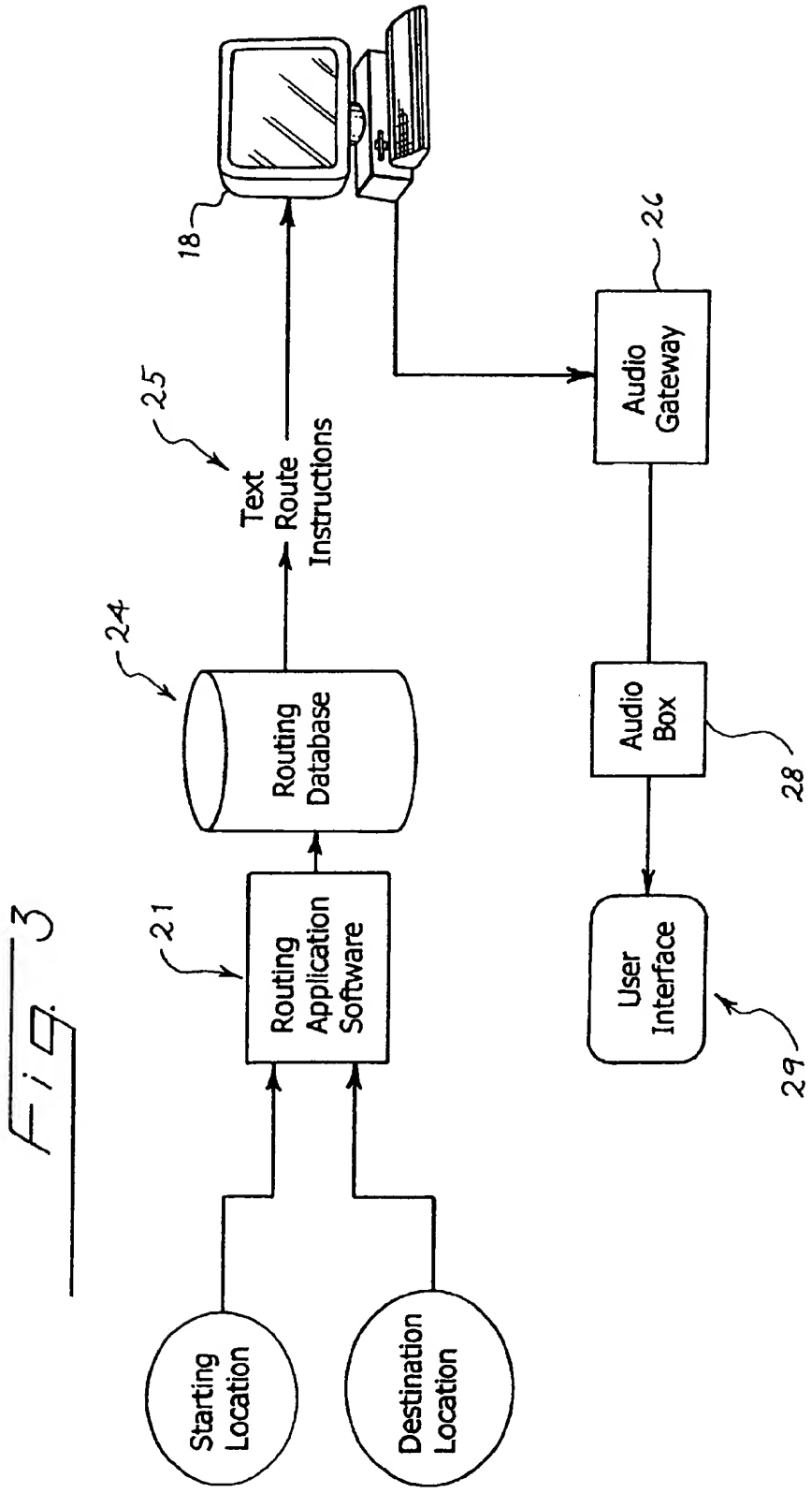

18
26
Audio Gateway
25
Text Route Instructions
24
Routing Database
Audio Box
28
21
Routing Application Software
User Interface
29
Starting Location
Destination Location

Fig. 3

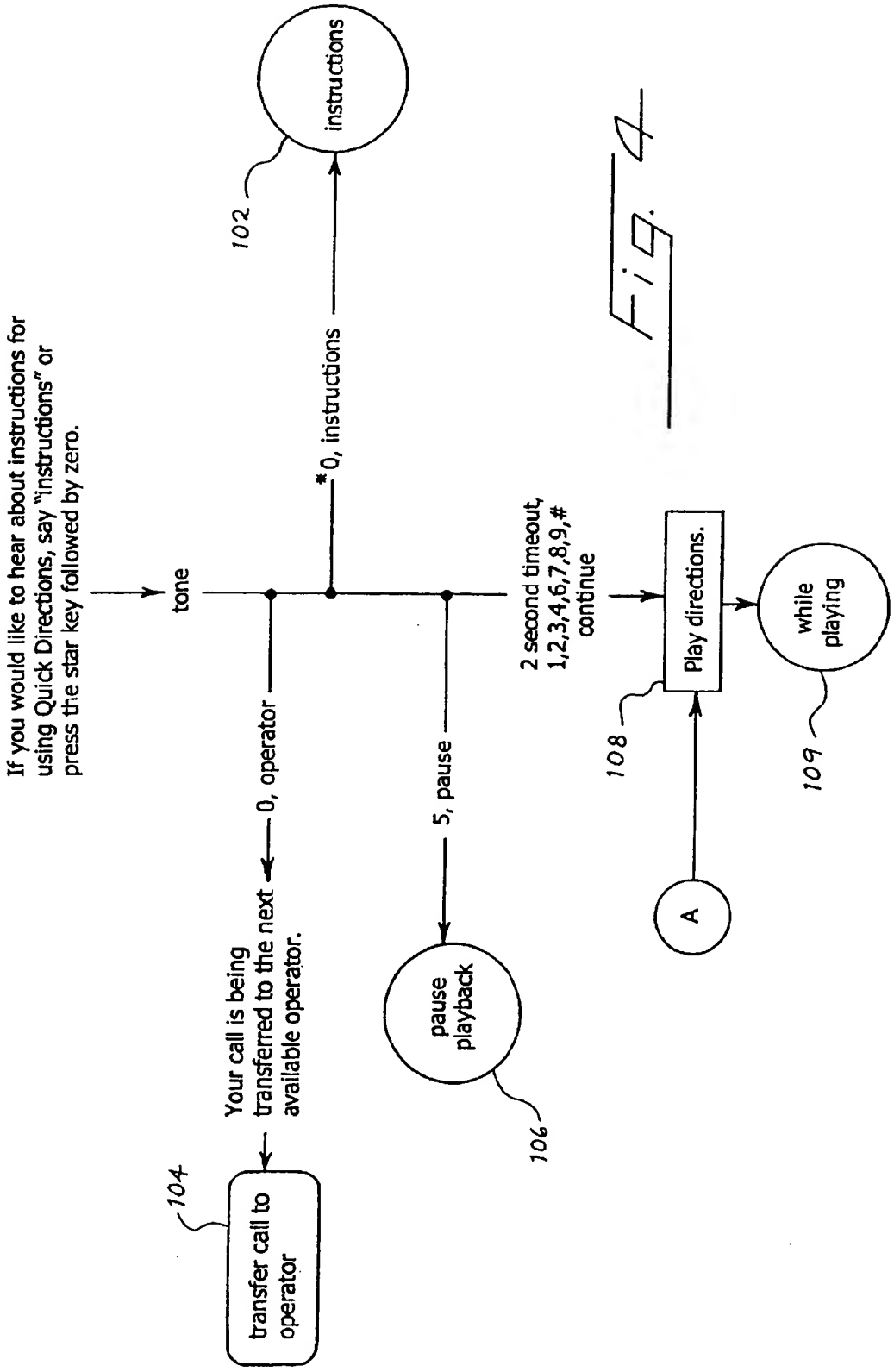

If you would like to hear about instructions for using Quick Directions, say "instructions" or press the star key followed by zero.
tone
*0, instructions
102
instructions
0, operator
Your call is being transferred to the next available operator.
104
transfer call to operator
5, pause
pause playback
106
2 second timeout, 1,2,3,4,6,7,8,9,# continue
108
Play directions.
while playing
109
A

Fig. 4

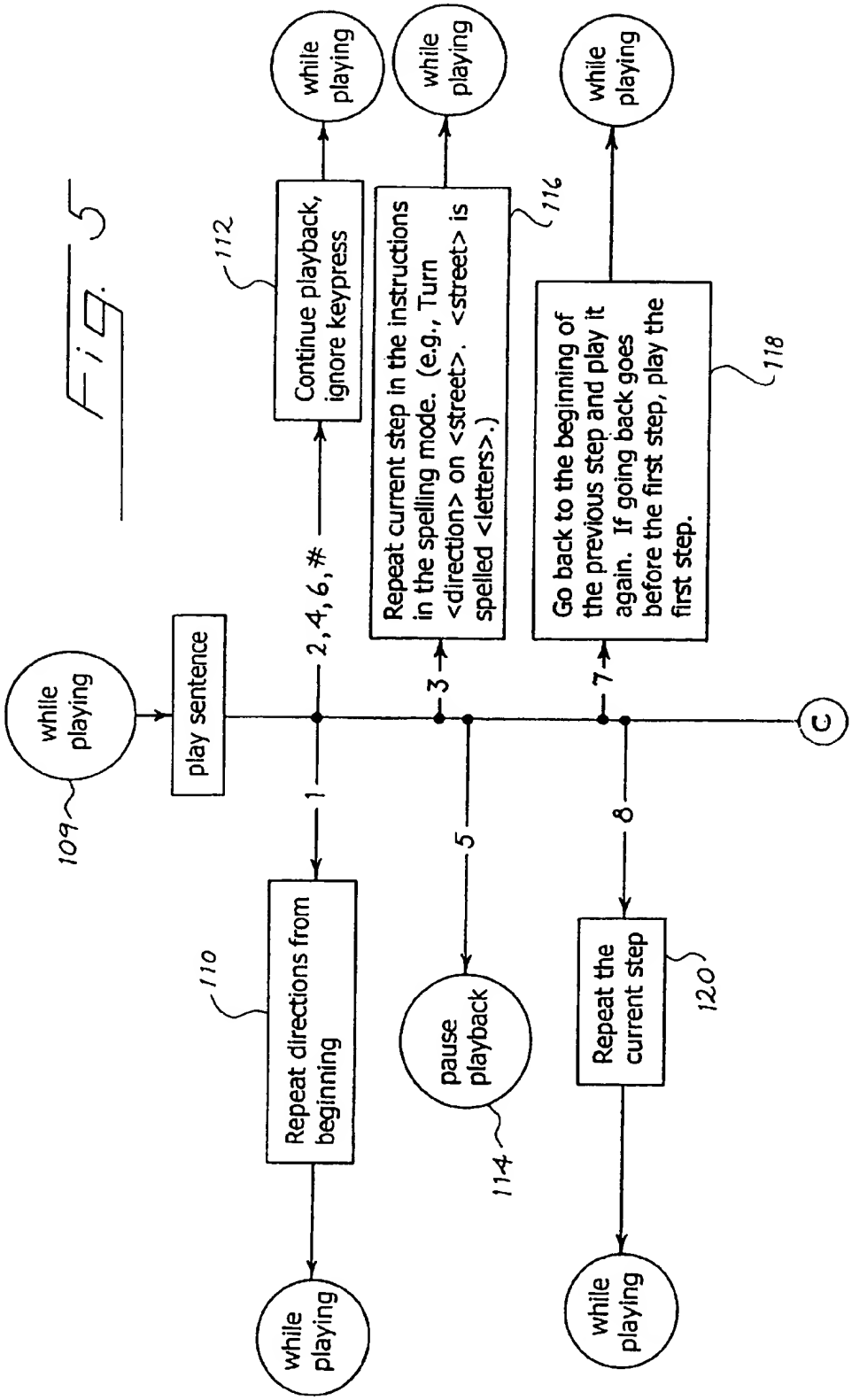

while playing
109
play sentence
1
2, 4, 6, #
Continue playback, ignore keypress
112
while playing
3
Repeat current step in the instructions in the spelling mode. (e.g., Turn <direction> on <street>. <street> is spelled <letters>.)
116
while playing
7
Go back to the beginning of the previous step and play it again. If going back goes before the first step, play the first step.
118
while playing
C
8
Repeat the current step
120
while playing
5
pause playback
114
1
Repeat directions from beginning
110
while playing

Fig. 5

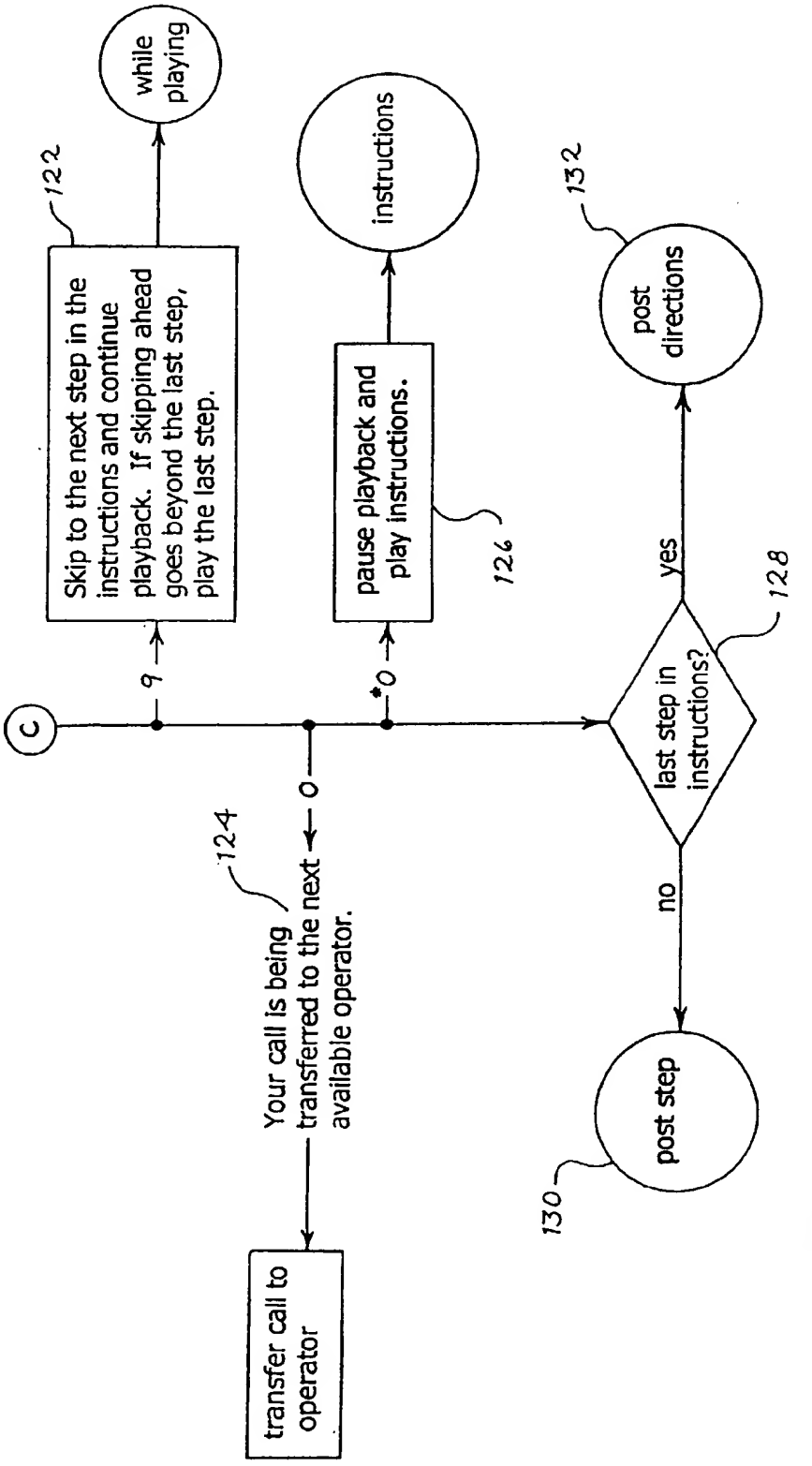


Fig. 5 (CONTINUED)

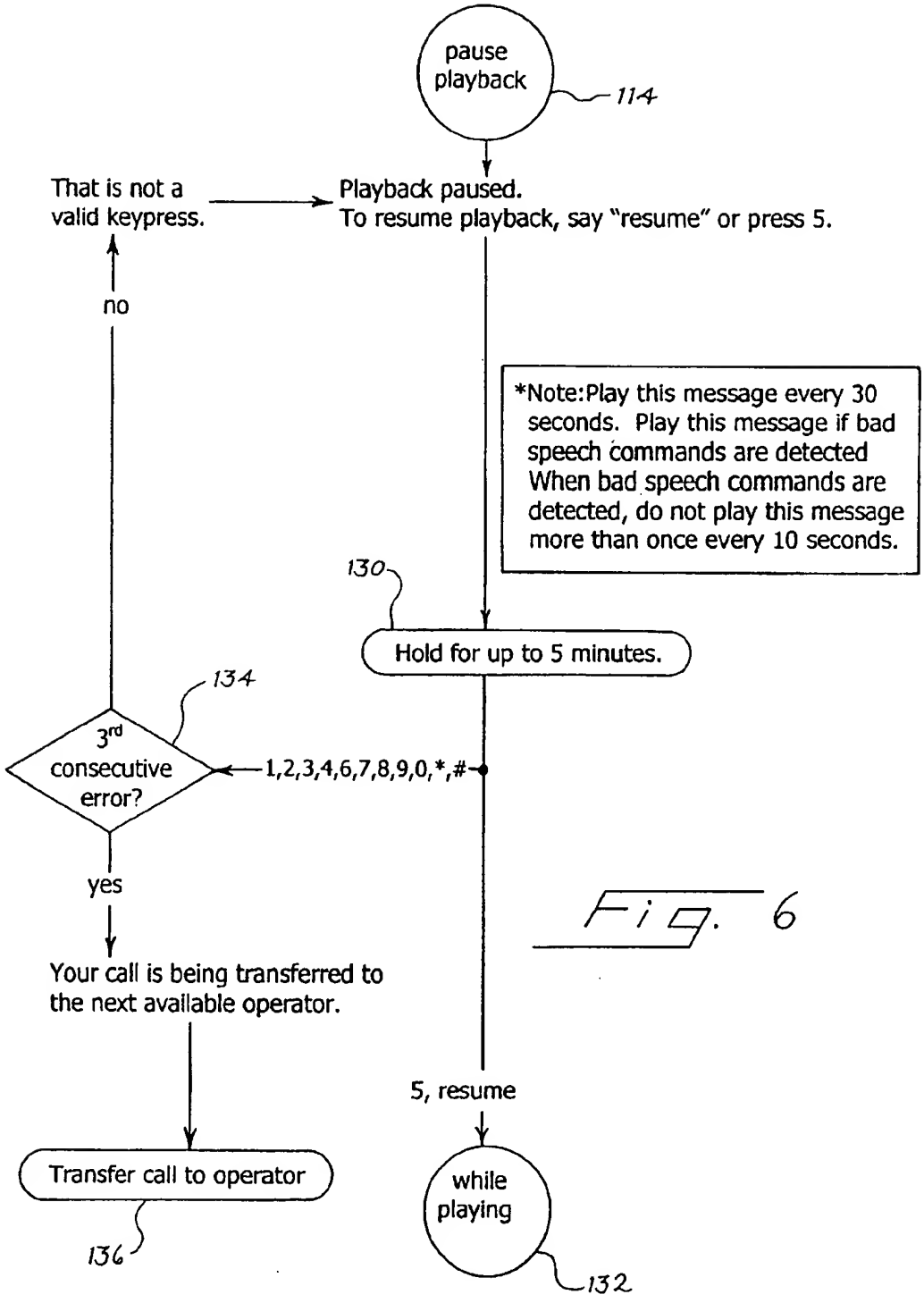

pause playback
114
That is not a valid keypress.
Playback paused.
To resume playback, say "resume" or press 5.
no
*Note:Play this message every 30 seconds. Play this message if bad speech commands are detected When bad speech commands are detected, do not play this message more than once every 10 seconds.
130
Hold for up to 5 minutes.
134
3rd consecutive error?
1,2,3,4,6,7,8,9,0,*,#
yes
Your call is being transferred to the next available operator.
5, resume
Transfer call to operator
while playing
136
132

Fig. 6

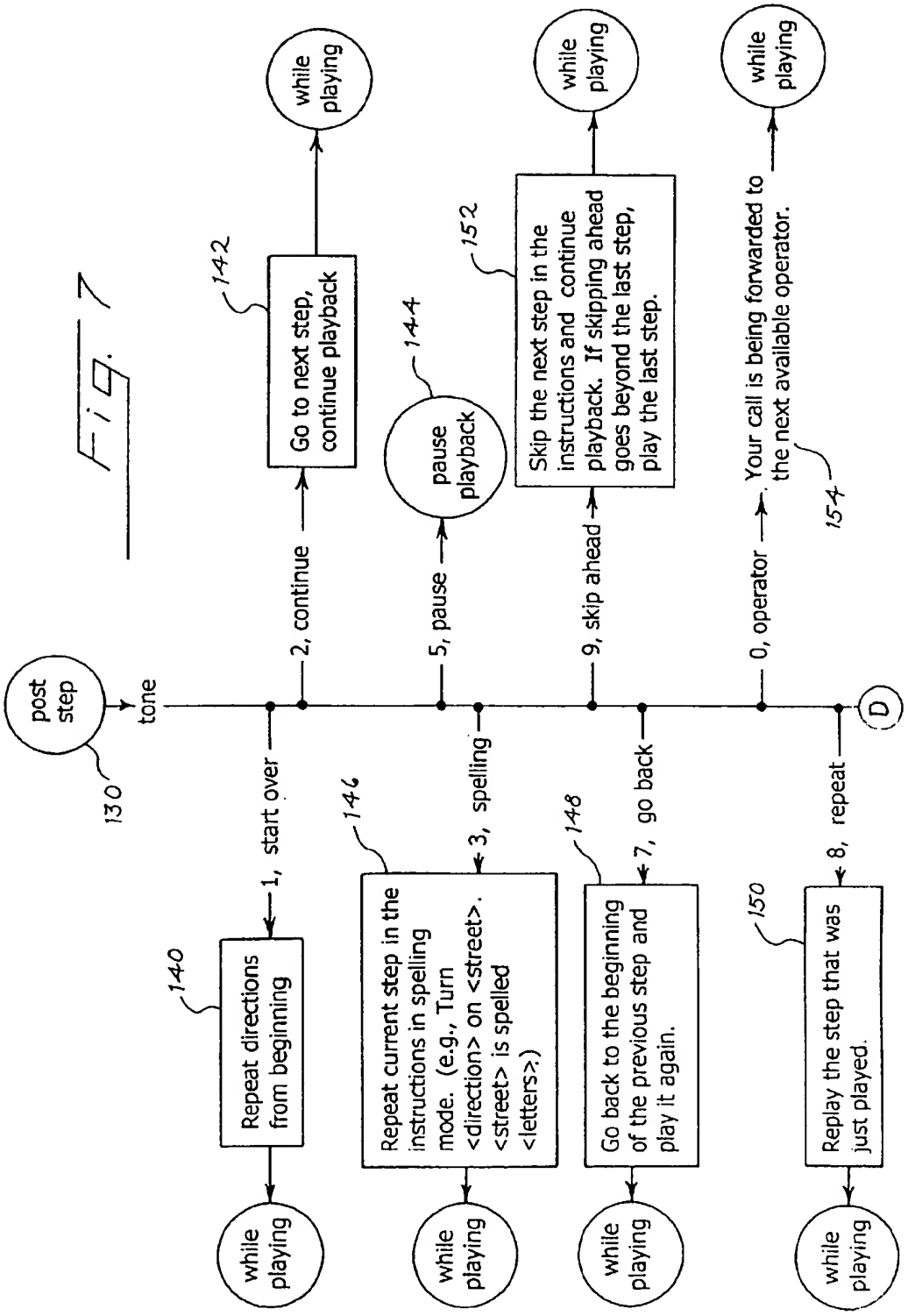

post step
130
tone
1, start over
2, continue
3, spelling
5, pause
7, go back
8, repeat
9, skip ahead
0, operator
D
140
Repeat directions from beginning
while playing
142
Go to next step, continue playback
while playing
144
pause playback
146
Repeat current step in the instructions in spelling mode. (e.g., Turn <direction> on <street>. <street> is spelled <letters>.)
while playing
148
Go back to the beginning of the previous step and play it again.
while playing
150
Replay the step that was just played.
while playing
152
Skip the next step in the instructions and continue playback. If skipping ahead goes beyond the last step, play the last step.
while playing
154
Your call is being forwarded to the next available operator.
while playing

Fig. 7

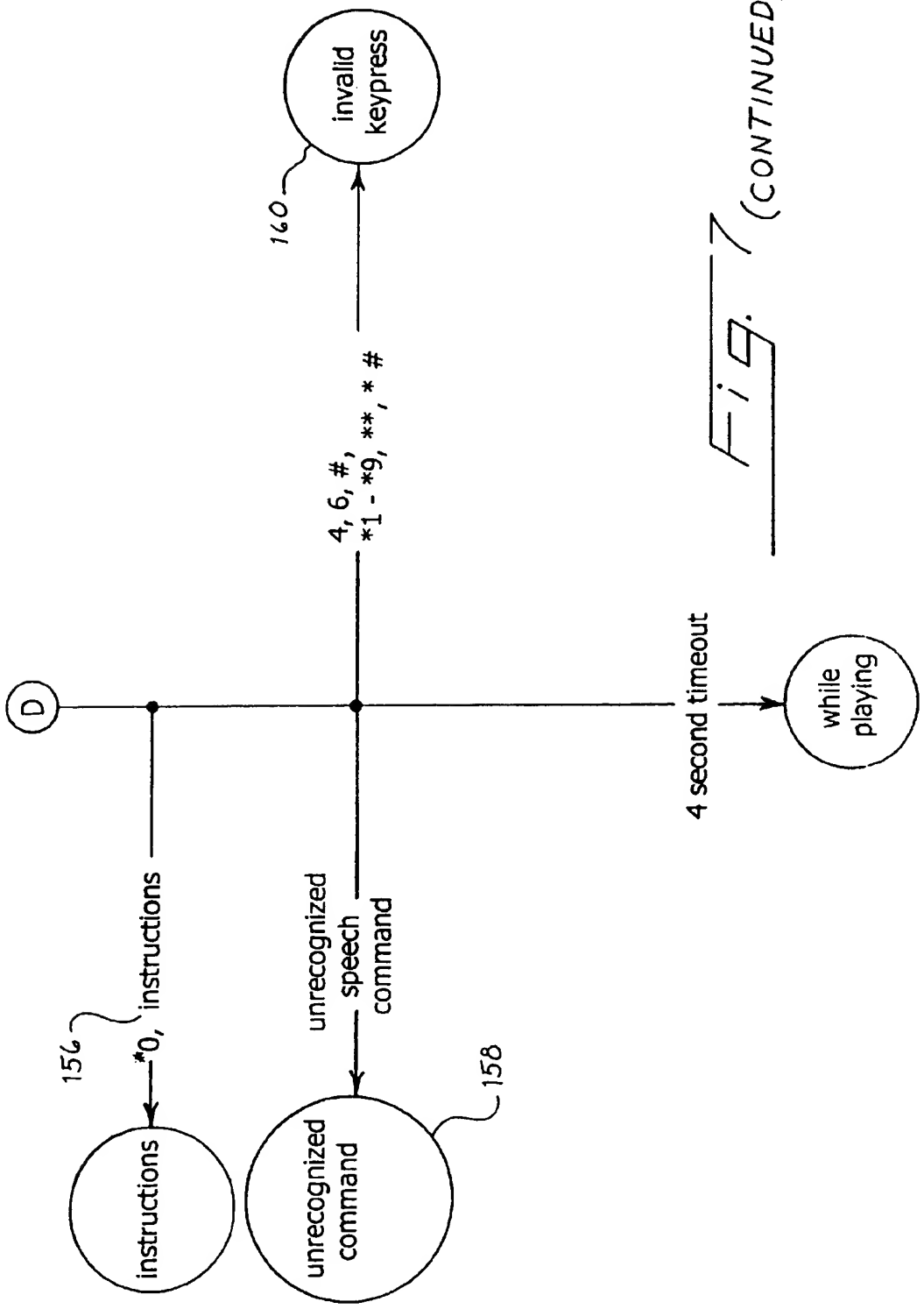
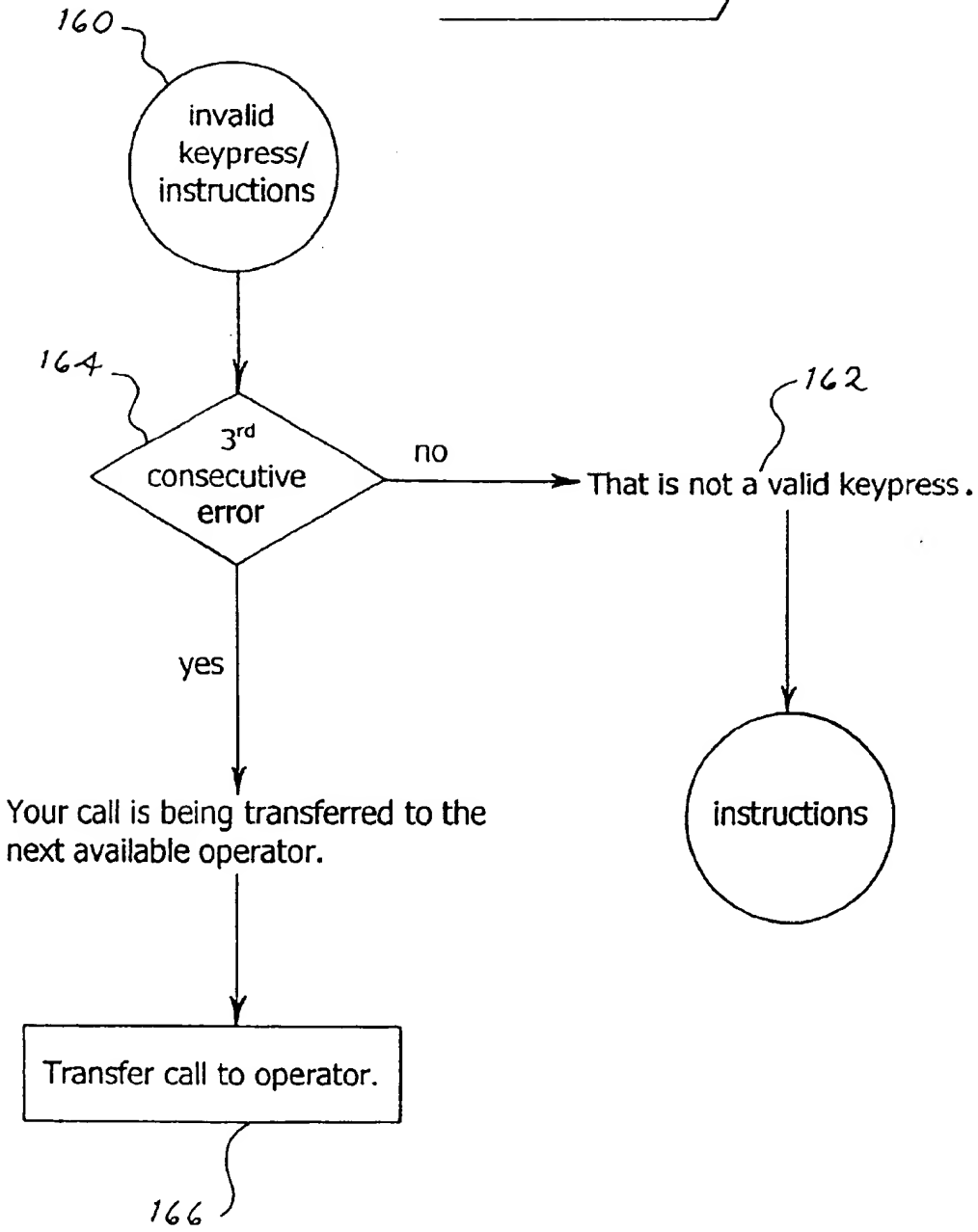


FIG. 7 (CONTINUED)

Fig. 8


160
invalid keypress/ instructions
164
3rd consecutive error
no
162
That is not a valid keypress.
yes
instructions
Your call is being transferred to the next available operator.
Transfer call to operator.
166

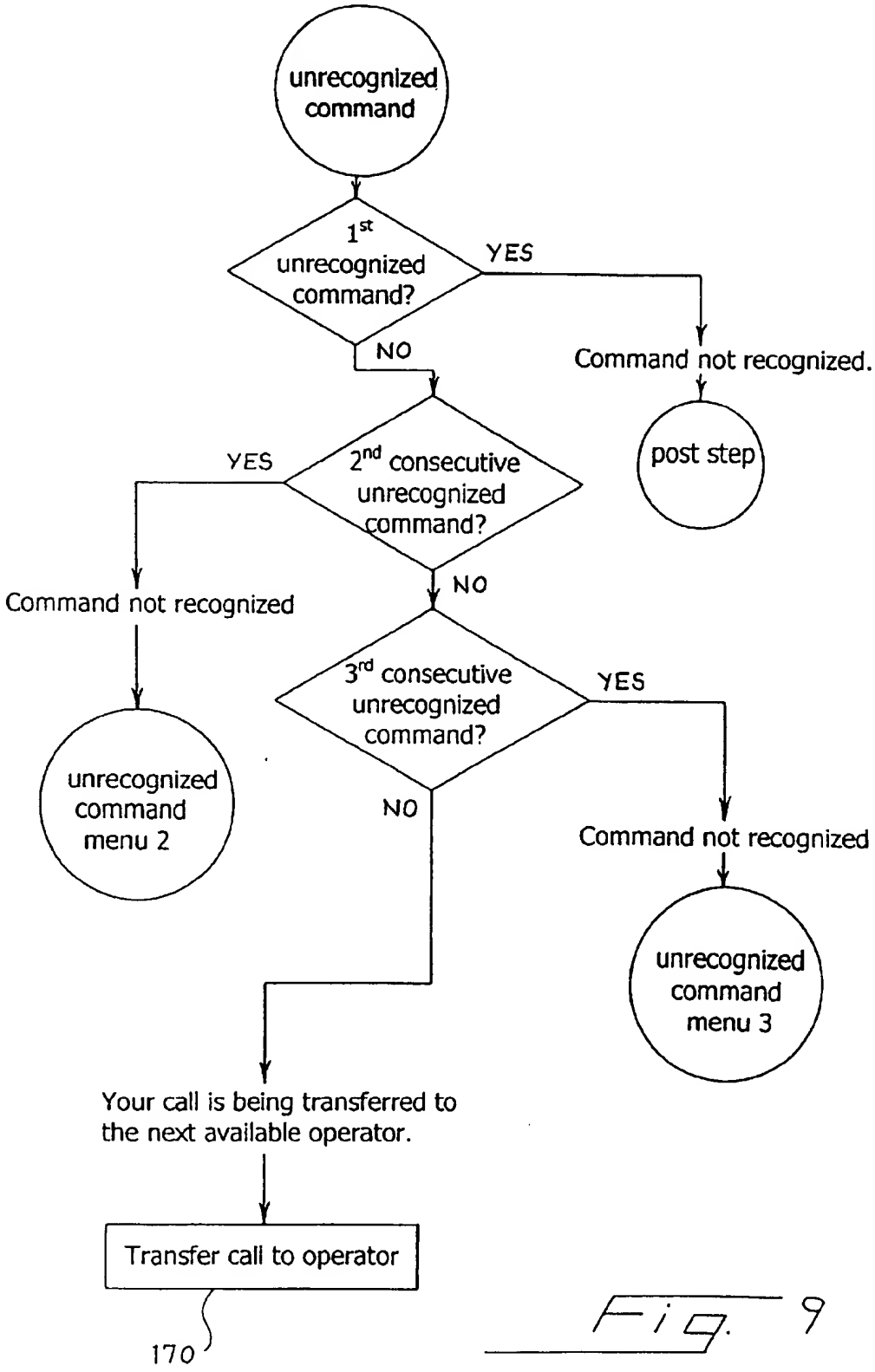

unrecognized command
1st unrecognized command?
YES
NO
Command not recognized.
post step
2nd consecutive unrecognized command?
YES
NO
Command not recognized
unrecognized command menu 2
3rd consecutive unrecognized command?
YES
NO
Command not recognized
unrecognized command menu 3
Your call is being transferred to the next available operator.
Transfer call to operator
170

Fig. 9

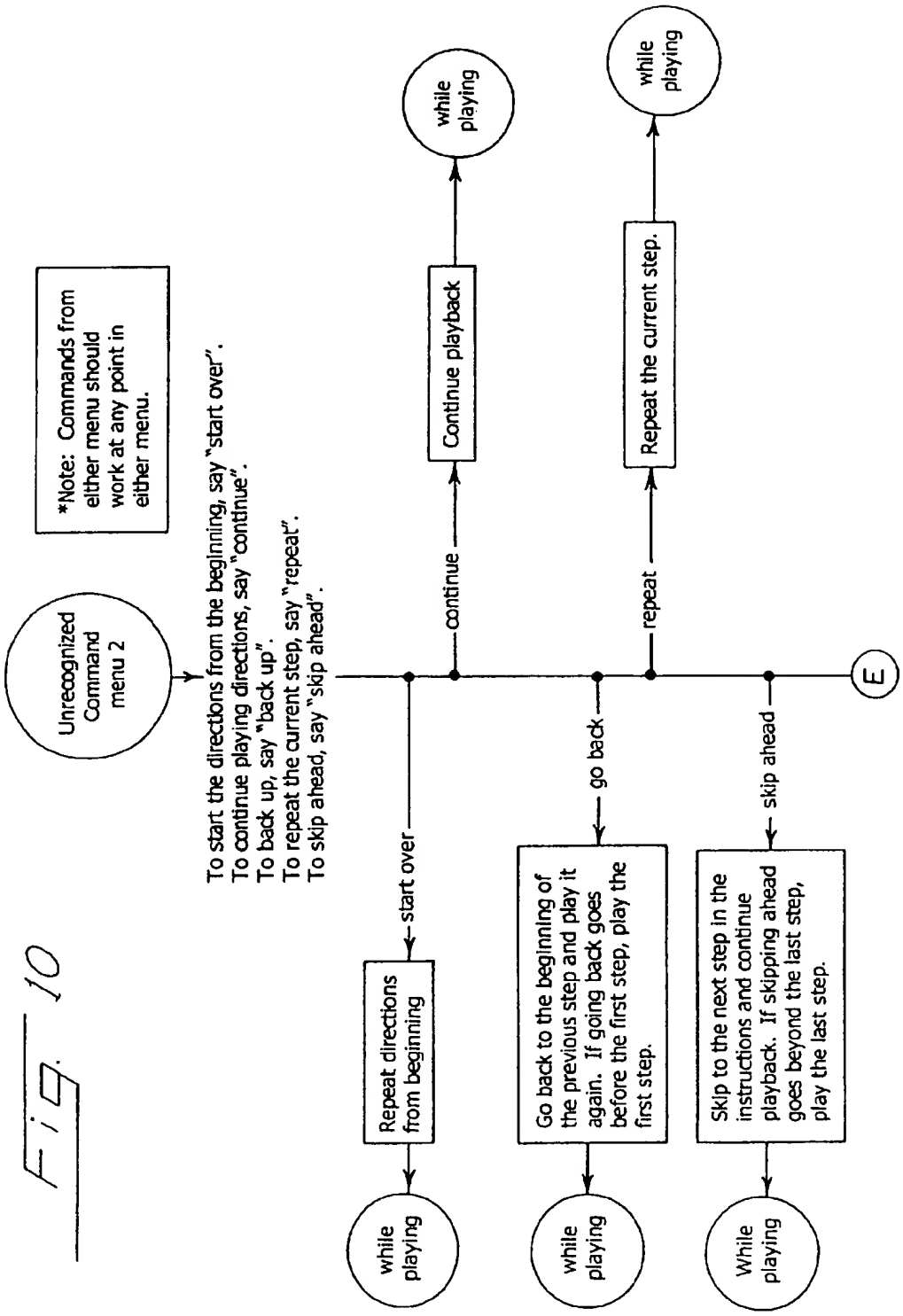

Unrecognized Command menu 2
*Note: Commands from either menu should work at any point in either menu.
To start the directions from the beginning, say "start over".
To continue playing directions, say "continue".
To back up, say "back up".
To repeat the current step, say "repeat".
To skip ahead, say "skip ahead".
start over
continue
go back
repeat
skip ahead
E
Repeat directions from beginning
Continue playback
Go back to the beginning of the previous step and play it again. If going back goes before the first step, play the first step.
Repeat the current step.
Skip to the next step in the instructions and continue playback. If skipping ahead goes beyond the last step, play the last step.
while playing
while playing
while playing
while playing
While playing

Fig. 10

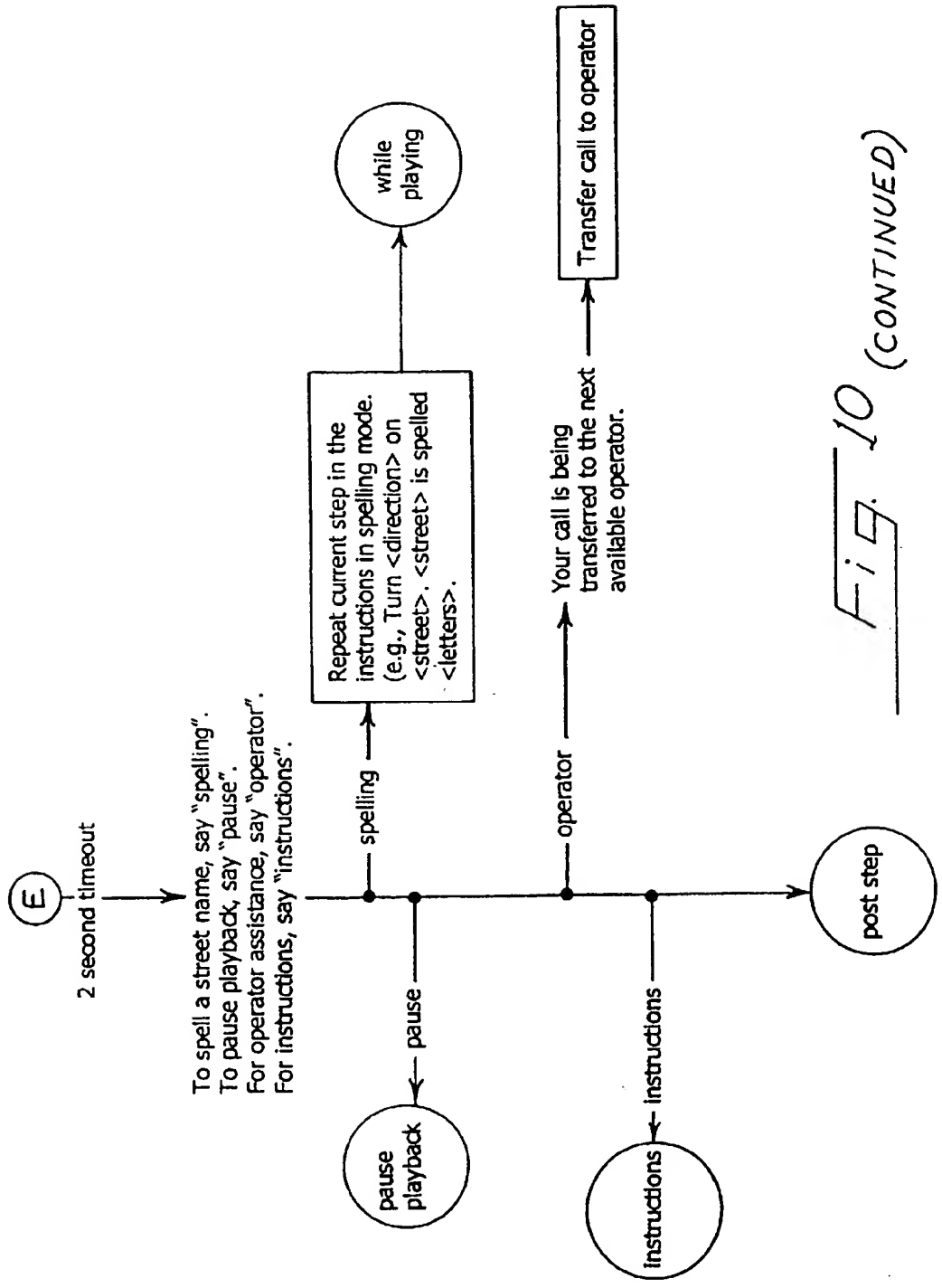


Fig. 10 (CONTINUED)

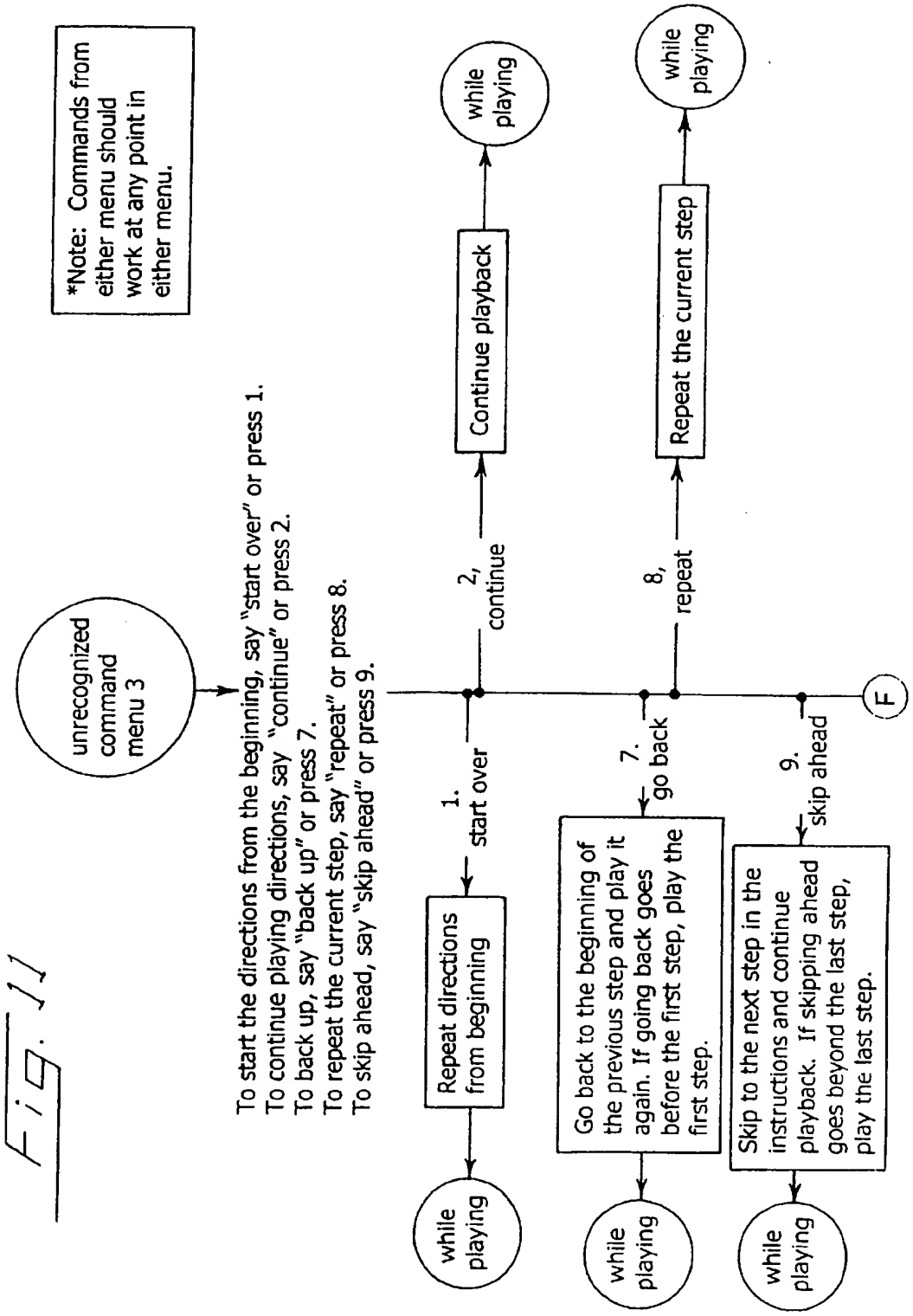

*Note: Commands from either menu should work at any point in either menu.
unrecognized command menu 3
To start the directions from the beginning, say "start over" or press 1.
To continue playing directions, say "continue" or press 2.
To back up, say "back up" or press 7.
To repeat the current step, say "repeat" or press 8.
To skip ahead, say "skip ahead" or press 9.
1. start over
2, continue
7. go back
8, repeat
9. skip ahead
F
Repeat directions from beginning
Continue playback
Go back to the beginning of the previous step and play it again. If going back goes before the first step, play the first step.
Repeat the current step
Skip to the next step in the instructions and continue playback. If skipping ahead goes beyond the last step, play the last step.
while playing
while playing
while playing
while playing

Fig. 11

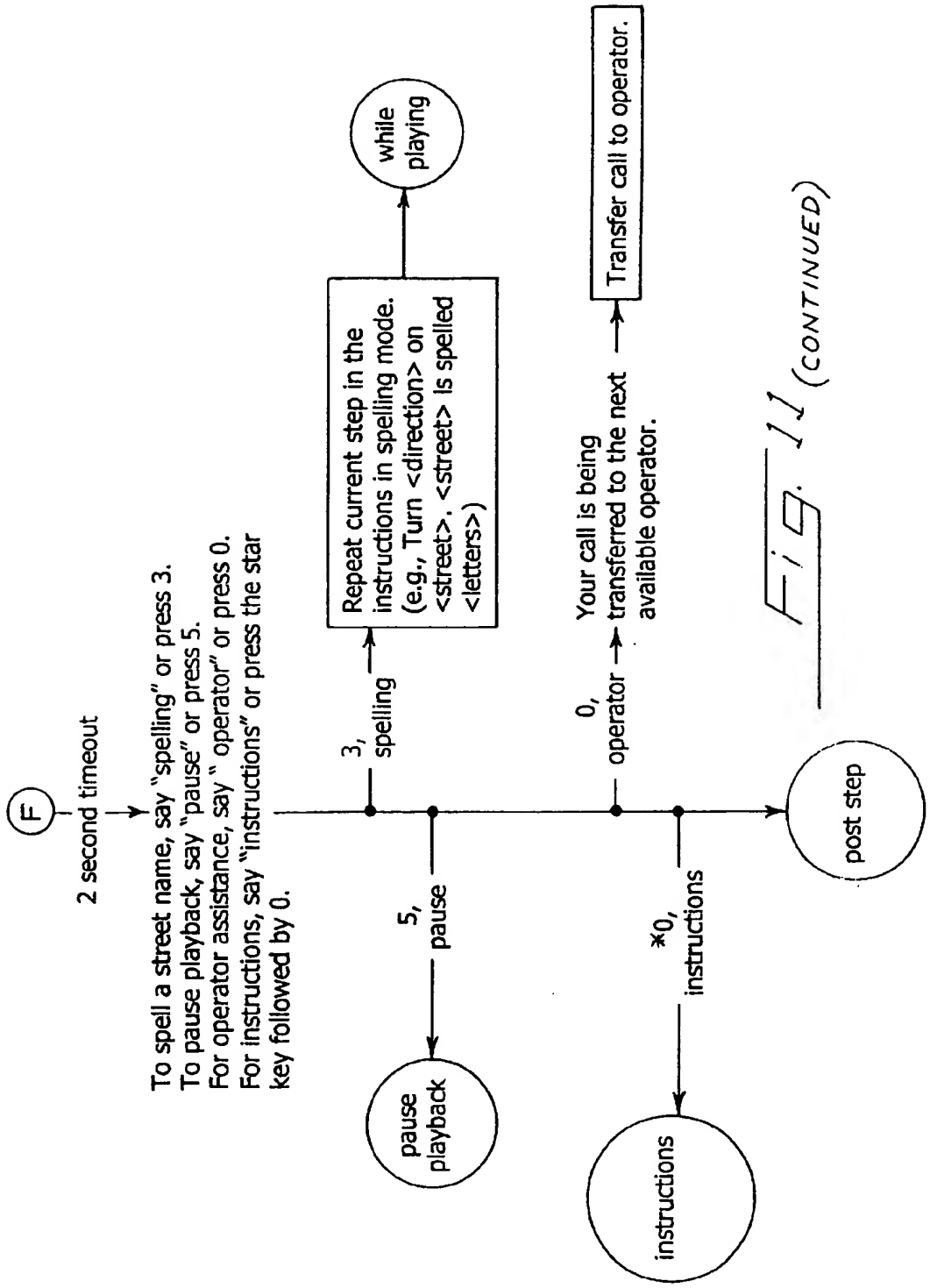
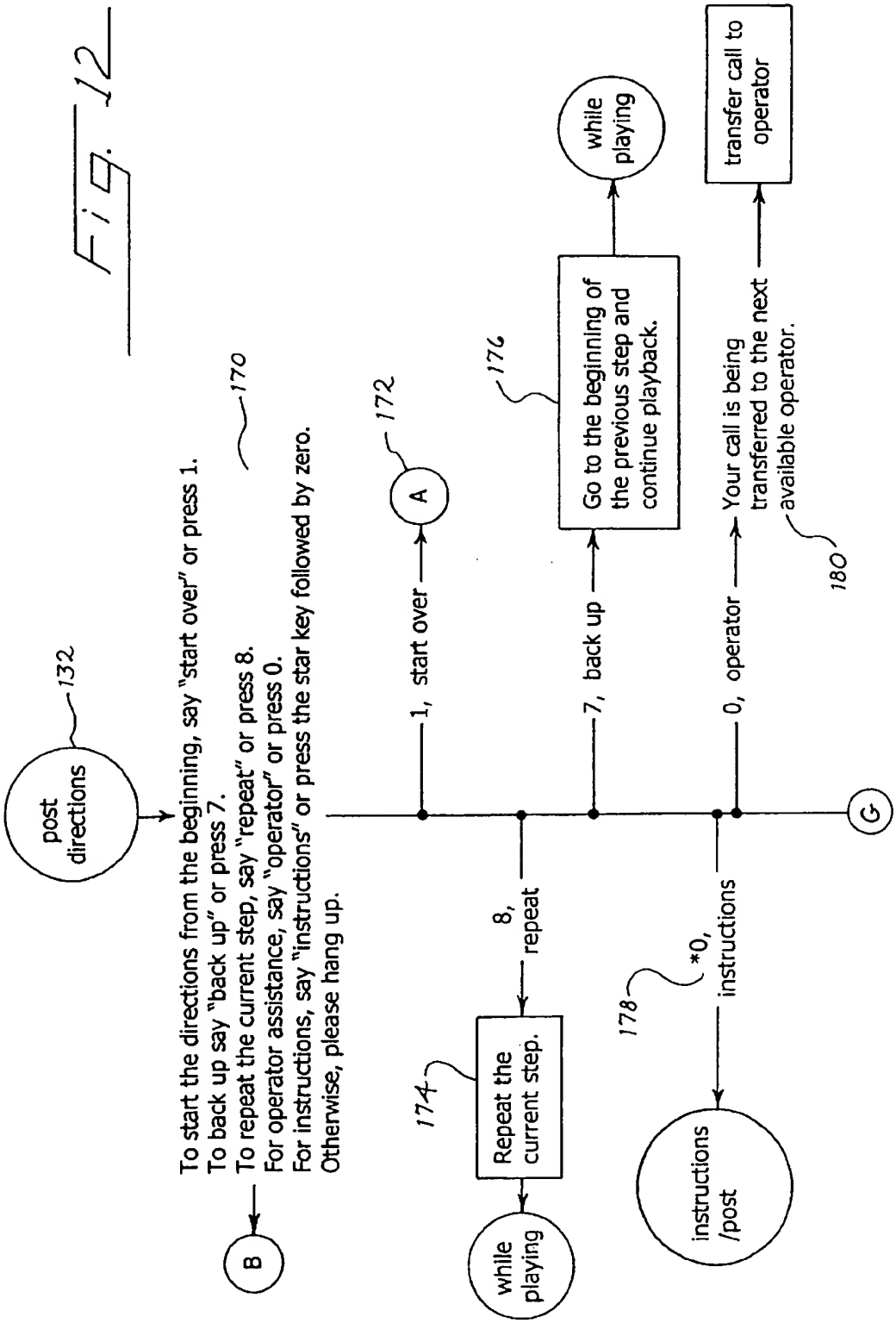
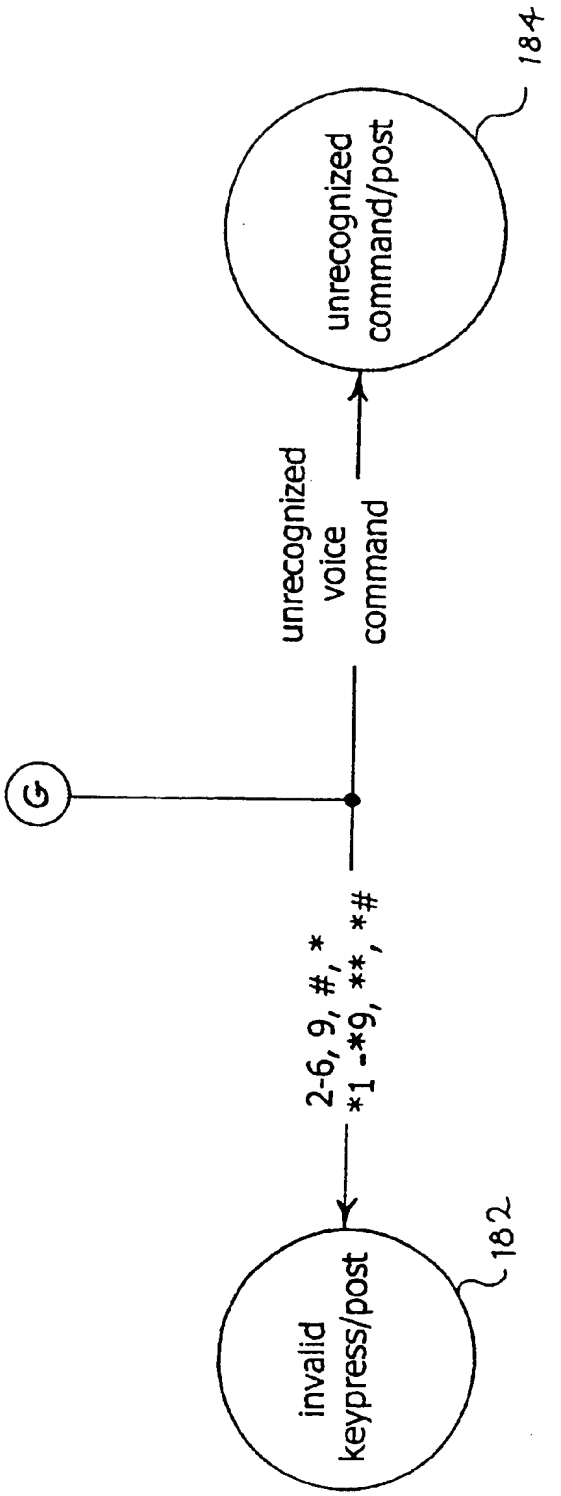


FIG. 11 (CONTINUED)

Fig. 12


post directions
132
To start the directions from the beginning, say "start over" or press 1.
To back up say "back up" or press 7.
To repeat the current step, say "repeat" or press 8.
For operator assistance, say "operator" or press 0.
For instructions, say "instructions" or press the star key followed by zero.
Otherwise, please hang up.
170
B
1, start over
A
172
7, back up
176
Go to the beginning of the previous step and continue playback.
while playing
0, operator
Your call is being transferred to the next available operator.
180
transfer call to operator
G
8, repeat
174
Repeat the current step.
while playing
*0, instructions
178
instructions /post



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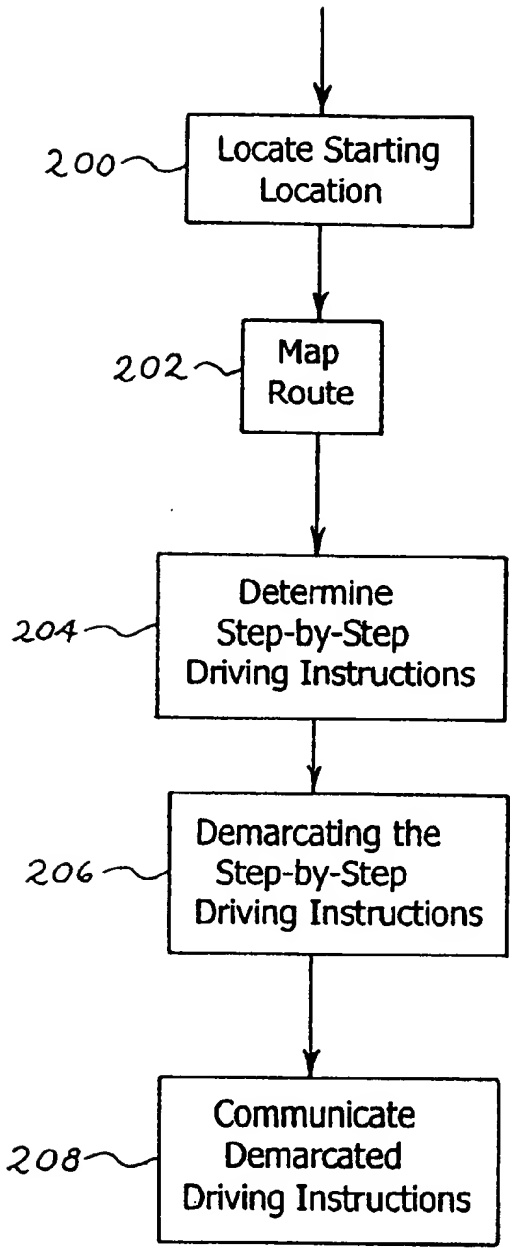
200
Locate Starting Location
202
Map Route
204
Determine Step-by-Step Driving Instructions
206
Demarcating the Step-by-Step Driving Instructions
208
Communicate Demarcated Driving Instructions

Fig. 13

METHOD AND SYSTEM FOR PROVIDING QUICK DIRECTIONS

BACKGROUND OF THE INVENTION

A. Field of the Invention

The present invention relates to a method and device for providing information assistance to telephone callers. More particularly, the present invention is capable of providing information assistance based on an automatic identification of the caller's location and providing an user interface to communicate the information over the telephone to the caller.

B. Description of the Related Art

Today, travel directions to a destination location can be obtained in different ways. Internet web sites now provide map routing software that generate and display driving instructions from one starting location to another destination location. The traveler enters the desired starting (from) location and the desired destination (to) location into the software program and has the option to select the fastest, easiest, or shortest distance driving directions to the destination location. The map routing software determines the route to the destination and displays it on the user's display terminal with step-by-step driving directions, estimated travel times, and mileage from the starting location to the ending location. This type of map routing software, however, requires a traveler to plan his trip in advance and have Internet access. It is of little assistance in the situation when a traveler becomes lost during his trip, needs assistance with directions, and does not have ready access to the Internet.

Recently, Global Positioning Satellite ("GPS") navigation systems allow a traveler to track his location in real-time as he travels on the surface of the earth. In-car GPS-guided navigation systems allows an automobile driver to track his current location in real-time and obtain voice and visual directions on how to get from his current location to a destination location. Destination locations can be selected from an in-car terminal by street address, street intersections, or city. These on-board navigation systems also include categorical search tools that allow users to find points of interest such as museums, parks, airports, stores, etc. To reach his destination, the driver is given specific driving instructions from an in-car terminal on how far to proceed and when to turn and exit. These on-board navigation systems, however, are complex and expensive, require a considerable up front investment and a complex installation procedure.

Today, many wireless telephone service providers also provide a telephone service that allows users to dial "*nnn" or a 7/10 digit telephone number to reach a live operator who can provide expressway travel times, weather conditions and driving directions. The callers specify their current and future locations by providing the nearest cross street intersection or street address. Destinations can be selected by white or yellow page listings, street address, or cross street intersection. The live operator also has categorical search tools that allow callers to find points of interest. This service, however, requires the caller to specify their current location and is therefore not useful to those who are lost and uncertain of their current location.

In addition, the retrieval of driving instructions over the telephone requires a live operator to relay the driving instructions to the caller. The caller must transcribe each sequence of the driving directions while the operator waits on the telephone, thus reducing the productivity of the operator.

Needed is an improved system to information and travel directions, which is readily accessible to travelers.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the present invention will be more readily appreciated upon reference to the following disclosure when considered in conjunction with the accompanying drawings, in which:

FIG. **1** is an overall system diagram of a system;

FIG. **2** shows an illustrative diagram of a call detail record used in the system of FIG. **1**;

FIG. **3** shows an diagram of the generation of route instructions used in the system of FIG. **1**;

FIGS. **4** through **12** are command menu charts of an illustrative embodiment of the interactive user interface used in the system of FIG. **1**; and

FIG. **13** is a flow chart of an illustrative method used in the system of FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present embodiment allows telephone callers to place a telephone call to a telephone number to obtain information and assistance in locating selected destination locations and obtain step-by-step driving directions to reach the selected destination locations over the telephone. An illustrative embodiment provides the ability to automatically identify the calling party's calling location without requiring the caller to manually identify his location. The calling location can then be used to map a route to the destination location and determine the proper driving instructions for the caller to arrive at the requested destination location.

In a described embodiment of the invention, telephone callers place a telephone call to access the system and select a desired destination location. The destination location may be selected from a white or yellow pages listing through an automated interactive voice response system or a live human operator. The destination location may be any locations such as a person or individual, or a street address, hotel, stores, restaurant, business office, etc. listed in the white or yellow pages directory.

After selecting the desired destination location, the caller may receive driving route instructions to the destination location from the system. For example, the caller's location and the desired destination location is sent to a database with application software which can map a route and provide driving instructions from the caller's location to the desired destination location or from another location to the desired destination location. The database and application software maps the driving route and determines step-by-step driving instructions to reach the destination. In a particular embodiment, the route to the destination location can be mapped taking into account the route traffic, travel-times, road conditions, and route weather conditions.

The caller may receive the driving or route instructions in a variety of different ways. The route instructions can be communicated directly over the telephone from an interactive voice response system, a live operator, a synthesized voice, a voice mail message, and Internet electronic mail, an alpha/numeric pager or telephone or a Personal Digital Assistant ("PDA").

In another aspect of the present embodiment, an interactive user interface to provide access to information over the telephone is described. The user interface is particularly adapted to provide a convenient interface so that a user can

obtain route or driving instructions to a destination location over a voice telephone call. The user interface provides a number of commands or specified keys to allow a listener to easily stop, start, review, and skip through the step-by-step route driving instructions. The route instructions may be coded to demarcate points that are convenient points to stop and start the instruction messages such that the user can listen and record the instructions or listen and pause the instructions while they are actually driving the route. The user interface provides a convenient mechanism for callers to obtain the route instructions, as well as other information over the telephone.

FIG. **1** shows a system level diagram of an illustrative embodiment of the present invention. Shown in FIG. **1** are a telephone subscriber or caller **12** accessing the system as a caller seeking assistance, an access or switching network **14** such as the Public Switched Telephone Network ("PSTN") provided by local telephone companies such as Ameritech and long distance carriers such as AT&T and WorldCom/MCI. A switch device **16** such as a DMS-**200** from Nortel or an Automatic Call Distributor ("ACD") such as those from the Rockwell Corporation, which provides access to and routes calls through the system. Also shown is an operator console or workstation **18** where a human operator to handle calls may be located, and a database **20**, which may include a plurality of databases. In an illustrative example, the database **20** may include a directory listing database **22**, a GEO TN database **23**, and a routing database **24**. Also shown is a gateway **26** interface that receives driving route instructions generated from the routing database **24**. The gateway **26** interface translates the text route directions to interface the route directions to the audio box **28**. For example, the route instructions may be generated in a text format that the gateway **26** interface translates to a data format appropriate for the audio box **28**. The appropriate data format may be a specialized text format that can be forwarded on to the audio box **28**. The audio box **28** translates the route instructions into audio speech that can be heard by a caller using speech synthesis. The audio box **28** allows a caller to retrieve directions without the continued interactive assistance of a human operator.

Described below in connection with FIG. **1** is an overview of an illustrative embodiment of the system in operation. A telephone caller or user **12** desiring assistance with a variety of services such as travel directions, maps, weather, traffic travel times, directory assistance white page listings, and road conditions originates a telephone call to a dial-in telephone access number to access the system **13**. For example, a landline or a mobile cellular telephone subscriber **12** dials the telephone number of the dial-in access telephone number. The telephone call is routed through the switching network **14** to the dial-in access telephone line terminated to the switch **16**. The switching network **14** may include the PSTN as previously described. The dial-in telephone access number is preferably a double digit, 7-digit, 10-digit or toll free telephone number such as an "800" or "888" telephone number. To provide greater call capacity, a high-capacity telephone line, such as a T1 or Primary Rate Interface circuit may be used to implement the access telephone line. Wireless telephone users may be configured to simply dial a "*NNN" to access the system. In a preferred embodiment, the service may be accessed through a basic "411" directory information service. For example, callers may dial 411 to obtain directory information and also be given the option to obtain street driving instructions to the requested directory listing. If driving route directions are desired, the telephone call may be routed to the appropriate operator console to handle obtaining the driving instructions. Alternatively, the system may be setup such that all the 411 operators are trained and equipped to handle the calls requesting driving instructions.

The switch **16** answers the incoming telephone call arriving on the access telephone number and forwards the call to the operator console **18** where a live operator can handle the call. The switch **16** can be any suitable switching equipment such as an ACD, DMS series switch from Nortel, #5 ESS from Lucent Technologies, Galaxy 500 or other Private Branch Exchange ("PBX") switching equipment. The switch may also be embodied as an automatic call distributor ("ACD") that automatically distributes incoming calls in the sequences that they are received.

Preferably, a call detail record data structure is also created and sent to the operator console **18** along with the forwarded telephone call. The call detail record may contain a variety of information regarding the arriving telephone call which can be displayed on the operator console **18** to provide the operator information regarding the incoming telephone call. In the illustrative embodiment, the call detail can include a number of pre-populated fields to show the operator a number of details regarding the call such as the calling telephone number, the called telephone number, the location of the caller, and the station type of the calling telephone number. Different station types such as coin or pay station, residence, or hotel telephone systems are well known to those skilled in the art. For example, in an illustrative embodiment the calling location of the incoming telephone calling is determined using a suitable calling telephone location technology **17** as will be described in further detail below. The location of the caller determined by the ANI is sent to the call detail record to the operator console **18**.

The operator console **18** displays the call details to the operator while the call is being handled. Referring now to FIG. **2**, shown is an exemplary display of the operator console **18** while handling a call requesting directions to a destination location. It should be understood that FIG. **2** is a simplified illustrative drawing and the operator console display can be implemented as a Windows-type interface. At the bottom of the screen, a call detail window **32** can display call information from the call detail record, such as the ANI or location where the caller and the desired ANI where the caller wishes the directions to start. Often the caller's ANI and the desired ANI will be the same. The caller may also, however, request that directions be given from a different location, resulting in a different desired starting location. The address fields and the cross street information can be determined from the ANI and the database information. The station type of the caller may also be displayed, but is not explicitly shown in this example. The operator views the call details and queries the subscriber **12** for his or her request. Preferably, the caller's location is automatically identified and displayed on the operator console **18** as described above. Of course, the operator can request the caller for the starting location to confirm the automatically identified location. The operator can accept the information in the call detail window **32** or make any changes or correction to the information before making the request to the database to map the route.

The caller's request is entered into the operator console **18** or if the caller wishes to search for a destination location, a search is launched against a listing database for candidate listings according to the caller's request. In the illustrative embodiment of the invention, the listings that can be searched include desired destination locations such as street addresses, hotels, stores, restaurants, business offices and the like that may be listed in the white or yellow pages.

If the desired listing(s) is found, the operator quires the caller **12** whether directions are need to the selected destination location or for any other location the caller **12** may be interested in obtaining routing information. If the caller wishes to receive directions to the destination, the operator uses the starting and destination locations to determined an appropriate driving route between the locations.

The starting and ending locations are be applied to a database **23** containing Geo-coded location information to obtain the physical geographic coordinates of the desired locations. The physical geographic coordinates allow the geographic locations of starting and destination locations to be determined. A geo-coded database provides geographic vertical and horizontal location coordinates in the form of latitude and longitude coordinates for nodes such as street addresses and significant landmarks.

Referring to FIG. **3**, the starting and destination locations are applied to a database **20** to map a route and create step-by-step route driving instructions between the starting location and the selected destination location. Preferably, a map routing software program **21** applies the geo-coordinates of the selected locations to the routing database **24** to determine appropriate routing instructions **25** from the starting geo-coordinate to the ending geo-coordinate as will be described in more detail below. In the illustrative embodiment, the route instructions or driving directions **25** are step-by-step street driving instructions. The route instructions **25** can then be passed to the operator console **18** for the operator to view and relay to the caller. Referring again to FIG. **2**, the route instructions can be displayed on the main portion or window **34** displayed on the operator console **18**. Preferably, the instructions are demarcated in a step-by-step manner as illustrated in FIG. **2**.

To communicate the route information **25**, the operator may simply recite the route instructions to the caller, or alternatively may release the route instructions **25** to the text-to-speech audio system to automatically play the instructions to the caller. The text-to-speech audio system preferably includes an audio gateway **26** and audio translation box **28** suitable for translating text route instructions **25** to synthesized speech. In addition, the audio translation box **28** preferably includes an interactive user interface **29** that allows a user to control the playback of the driving route instructions. Using the interactive user interface **29**, a user can receive the route instructions **25** and control how the route instructions **25** are played back without the assistance of a live operator at the operator console. Use of the audio box **28** to provide instructions to the caller also improves the productivity of the human operator. The operator can pass the call on to the audio translation system to communicate with the user and proceed to handle the next caller.

Described below is a description of an illustrative embodiment of the present invention providing a more detailed description of the particular components.

Referring again to FIG. **1**, to initiate access to the system, the caller **12** preferably originates a telephone call to a dialup access telephone number. Telephone calls are primarily originated from either traditional fixed location landline telephones or mobile wireless telephones. Mobile wireless telephone may include cellular, personal communication systems ("PCS"), satellite telephones, etc.

After the telephone call is answered by the switch **16**, the geographical location of the telephone caller is determined using an appropriate caller location system **17** capable of identifying the geographical location of the caller. To identify the geographical location of the caller **12**, several techniques can be used depending on the particular telephone (i.e., landline or mobile telephone) originating the call. Several exemplary telephone caller location identification systems **17** are described below in further detail. The location of the caller **12** can then be communicated to the operator by including the geographical location with a call detail record data structure that is transferred to the operator console **18**.

For example, the location of a telephone caller **12** from traditional fixed location land-lines can be identified using the automatic number identification ("ANI") of the originating calling telephone number to index into a directory listing database or Name, Address and Telephone number Database ("NATD") **22**. From the ANI of the calling telephone number, the NATD **22** can be accessed for the address of the originating telephone number. The originating telephone number address can then be used to determine the geographic location of the telephone number by accessing the Geo TN or Geo-code database **23**.

In the exemplary system **14**, automatic number identification ("ANI") or a calling number location identification may be used to identify the originating calling telephone number which is passed in the call detail record to the operator console **18**. In the illustrative embodiment, the operator console **18** may access an IBM Reduced Instruction Set Computer ("RISC") with the AIX operating system such as provided with the directory assistance platform from the IBM Corporation. The operator console **18** can then access NATD database **22** to return the street address associated with originating telephone number. Preferably, the NATD database **22** contains the street address of all the telephone lines located in the contiguous United States. Such a NATD **22** can be provided in conjunction with the nationwide directory assistance platforms operated by the local exchange carriers or other telephone service providers. In the preferred embodiment, the NATD database **22** also contains physical geographic location information for each telephone line in the database as implemented in the Geo-code database **23**. For example, each telephone line listing may include physical location or geographic coding ("geo-coding") parameters such as physical x, y coordinates which can be utilized to identify the address and latitude and longitude coordinates of the originating telephone line. The physical location of a fixed land-line telephone call can be determined using ANI to identify the calling telephone number and then using the calling telephone number to index into the NATD database to access the geo-code location of the calling party as described above. Preferably, significant landmarks such as cross-street intersections, interstate highway exit numbers, local communities are also added to the NATD database with x, y geo-coding.

If the ANI telephone number of the caller **12** is matched by the NATD database **22**, the NATD record with the geo-code of the caller's location is included in the call detail which is passed on to the operator console **18**. If the caller's calling location cannot be automatically determined, a message is indicated in the call record sent on to the operator. The caller's location must then be manually identified through interaction with the human operator that the caller location was not available.

In another illustrative embodiment with wireless mobile telephone, the callers **12** may be mobile and their location will most likely vary with each telephone call. In this illustrative embodiment, an automatic location identification ("ALI") technology **17** is preferably used to determine the location of wireless telephone callers. The most common type of ALI technology **17** for mobile wireless telephones

utilizes a network-based approach that applies mathematical algorithms to the attributes of the wireless telephone radio frequency ("RF") signals received at a base station of the wireless network. Such location algorithms using the precise timing in which the RF signal arrives different base stations, the angle of arrival of the signal, and the amplitude of the signal are well known to those skilled in the art. To analyze RF signals, additional electronic hardware to analyze and locate the origin of the signals is required at the base stations. The main advantage of a network-based location technology is that it can be utilized with existing networks using existing telephone wireless handsets. A separate network to locate the caller and new caller handsets are not required.

Alternatively, ALI of mobile wireless telephone calls may be implemented with a dedicated radio location network using a separate infrastructure and different frequencies than those used by cellular, PCS, paging, mobile satellite or SMR carriers, to determine the location of the caller. A dedicated location network is employed to triangulate the position of the caller though an analysis of RF signals received at different points in the location network. Presently, the primary frequency band used for radio location is known as the location and monitoring services ("LMS") band at 902–928 MHz. An example of an ALI technology using a dedicated radiolocation network is provided by Teletrac, Inc. The Teltrac system is available primarily in major metropolitan areas for fleet management solutions such as automatic vehicle tracking ("AVL") and related assets tracking services. In addition, the most prevalent ALI technology today is Global Positioning Satellite ("GPS") technology. GPS technology uses a network of 24 earth orbiting satellites to track a GPS receiver's location on the earth with an accuracy between 60 and 300 feet. The GPS receiver's location is determined by triangulating a timing and distance measurement between a plurality of the earth orbiting GPS satellites and a GPS receiver on the surface of the earth. GPS location frequencies are provided by U.S. Government at well-known frequencies. Location technology equipment is available from a number of manufacturers such as Rockwell, Trimble or Navtech.

After the originating geographic location of the incoming call is determined, the call is sent to an operator console **18** to allow callers **12** to specify their desired destination location. Switching device **16** switches the incoming telephone call to the operator workstation **18** to connect the call with a live operator. The operator workstation **18** will display the ANI and calling location of the telephone caller **12** to the operator console **12** if the ALI has determined the caller's location. If ALI could not identify the caller location, the call detail will not show the caller's location on the operator console **18** and the live operator must query the caller to manually obtain the originating calling location.

After the location of the caller is identified, the caller location is included in a call detail that is sent to the operator console **18** and displayed to the operator. Because a caller's location has been determined, the operator need not query callers for their location unless there was problem with the ALI. The operator can then move on to immediately query callers for their requests, thus speeding the handling of calls and increasing the productivity of the operator.

The present embodiment can provide a variety of services for callers **12** such as those provided by directory assistance, weather, time of day, yellow pages assistance, etc. For example, in an illustrative embodiment a caller **12** may wish to obtain travel directions from his current location to a selected destination location. Callers **12** may request the operator conduct a search for a selected destination locations in a variety of different ways. For example, the caller may be seeking the restaurant or grocery store nearest his calling location. Using the location identified by the ALI, the operator can launch a database search for any such establishments in the proximity of the caller. In an illustrative embodiment, the destination location is selected from a white pages listing database that includes complete address information, x, y coordinates and geo-codes for each listing. The address information preferably includes street, city, state, zip code, municipality, community, and the county of the listed locations. In addition to simply identifying the listing, individual listings in a database **20**, such as a white pages listing database, can preferably be selected or categorically searched in many different ways. For example, the white page listings database may include a search engine that can search the database by street, city, state, zip code, municipality, community, county or any combination of fields. Appropriate search engines are available from a variety of sources including the IBM Corporation. The database **20** may also allow the selection of listings by category type of the listing, i.e., restaurants, gas stations, stores, libraries, airports, etc. In addition, the database **20** may also be searched for locations within a specific proximity or specified distance from the caller's location. In such a proximity search, the geo-code location of the caller is identified and the geo-codes of the categories of entries are searched for those entries within the desired location. In addition, various combinations of the different criteria may be utilized to search and select white page listings.

In a particular embodiment, callers may request information from the operator and select destination locations. The operators can access and search the database **20** in accordance with callers'requests to obtain and view the search results. The operator can also interactively relay listings, search results, and step-by-step driving instructions back to callers **12**.

In an illustrative embodiment of the invention, it is contemplated an automated interactive voice response system provided by the audio box **28** allows callers **12** to access the information without requiring a live human operator. Alternatively, a user may access the system using a computing device with a modem and a computer display. Preferably the computing device is a portable computer such as a handheld or pahntop computer which can be used by a caller who is traveling and away from the office. The portable computer may have any suitable interface and display for showing text and preferably even graphics capability for displaying maps. The portable computer may have a Windows CE, Palm OS, Apple Newton or other operating system suitable for a portable computer. Suitable computing platforms include portable devices such as a Palm Pilot, Apple Newton, portable Windows CE machines, or similar portable machines from Psion, Phillips, Hewlett-Packard, and other manufacturers of portable computing devices. These portable-computing devices can be used to access into the system on a dialup telephone line that can be provided to allow access by a computer terminal. Once accessed to the system, the user can operate the system through a computer interface, without requiring an operator.

After determining the caller's location and identifying the caller's desired destination location, a route between the two locations can be mapped and step-by-step driving directions generated according to the mapped route. The map routing software typically includes a database **20** such as a route information database **24** storing map routing information. The map routing software is applied to the database **20**

preferably containing street map or routing information to derive the appropriate route between the locations. The map routing software takes a starting location and a destination location and maps a route between the two locations using the geographic location coordinates of the starting and destination locations. The mapped route can then be used to generate concise step-by-step driving or route instructions from the starting location to the destination location. The total distance of the mapped route and estimated driving time and estimated time of the caller's arrival can also be provided. Preferably, the mapping software converts east, west, north, and south directions into left and right turn instructions. Map routing application software capable of generating driving directions are well known to those of skill in the art. For examples, such software can be found on the Internet at sites such as Mapquest, Expedia, Citysearch, and Mapblast.

In a particular embodiment, the mapping application software can be provided in conjunction with a variety of real-time information such as weather, traffic travel times, and road conditions. For example, local transportation authorities offer real time traffic information on the local highways and interstate roads. These systems typically provide travel times between selected locations as well as the speed of moving traffic at road sensors embedded into the roadway monitoring the speed of moving traffic. Road construction information is also provided by the location of the construction (i.e., "Eastbound I-88 at the Fox River Bridge"), the construction type (i.e., "Road Closure" or "Lane Closure") and the duration of the closure (i.e., "Feb. 20, 1998 08:00 to Feb. 20, 1998 14:00"). An example of this type of information is provided by the Gary-Chicago-Milwaukee ("GCM") Priority Corridor - Illinois Department of Transportation, Indiana Department of Transportation, and Wisconsin Department of Transportation in cooperation with the University of Illinois at Chicago Department of Electrical Engineering and Computer Science. The federal government has provided funding for these types of projects in the IVHS Act of 1991 as part of the Intermodal Surface Transportation Efficiency Act of 1991. Additional information can be found at the GCM web page on the Internet. The traffic/construction information can be used by the system to avoid routes that are closed or are experiencing undue delays due to construction. The system can be programmed to avoid mapping routes through construction routes by creating alternative routes, or recalculating routes not using the sections of road under construction.

The map routing application software generates text route instructions in a format that is human or machine-readable. The text route instructions can then be transmitted to the operator console **18** to allow the operator to view the route instructions. The operator may then relay the route instructions to the caller.

The mapped route and step-by-step driving directions can be conveyed to callers in a variety of different ways. Of course, the step-by-step travel directions can be retrieved by a human operator and relayed to a caller by having the human operator read the directions over the telephone to the caller. Requiring a live operator read driving route instructions, however, may be cumbersome and require the operator spend a long amount of time with each caller. The operator must read the directions and wait for the caller to hear and record or transcribe each step of the directions before the operator can release the call and proceed on to the next caller. The amount of time spent with each caller is thus relatively accordingly long, reducing the number of calls the operator can handle, and requiring a large number of operators to handle the expected volume of calls.

Callers accessing the system using a portable-computing device may download the route instructions to their computing device and review the instructions as necessary. The route instructions can be communicated over a telephone line using standard telephone modems, without requiring the interaction of an operator.

In another embodiment, callers receive the routing instructions over the telephone without requiring a portable-computing device or the interaction of a human operator. In this particular embodiment, the operator console **18** sends the text routing instructions from the route database **24** to an audio gateway **26** that interfaces the text instructions to a data format suitable for the audio box **28**. The operator console **28** also transfers the telephone caller **12** to the audio box **28**, which can then provide an interactive user interface to communicate the route instructions over the telephone.

For example, after retrieving the driving directions, the operator console **18** transfers the call to audio box **28**. The audio box **28** provides the interactive user interface system to communicate route instructions to the caller **12**. Preferably, the interactive user interface provides an interactive voice response system with speech recognition to implement an automated user interface to provide information to callers. The audio box **28** may include an Interactive Voice Response ("IVR") system having speech recognition and speech synthesis capability. Suitable audio speech boxes are available from the Lucent Corporation which can be programmed with the assistance of the descriptions herein.

The interactive user interface communicates the driving instructions to the callers and provides callers the ability to:

Pause and continue messages

Back up to previous steps or messages

Skip ahead to successive steps in the directions

Spell street names

Get instructions about using the system

Repeat instruction from the beginning

Return to a live operator

The system allows the caller to speak commands or use the touch-tone keypad on the telephone handset to enter commands to control the playback of the directions. Preferably, the interface supports dual tone multi-frequency ("DTMF") input and speech recognition with word spotting and barge-in capability. For example, after every menu and at each step of the instructions, a prompt tone is played to users to indicate the availability of the speech recognition commands. Preferably, the DTMF commands are always available to the user. The user will be allowed to perform actions with the DTMF commands while listening to instructions for using the system. Announcements and error messages are interruptible by the DTMF commands. Error messages, however, should not be interruptible. Preferably, the DTMF interface also supports a type-ahead buffer to allow users to move through the menus and select commands and options without waiting for the system prompts through the menus.

Travel directions may be given to callers using speech synthesis with a specialized vocabulary provided by the audio box. The route instructions or directions are given in a sentence-by-sentence manner and segmented or demarcated by the system on a sentence-by-sentence or turn-by-turn basis. Preferably, the directions are demarcated at each point where the user is given an instruction to turn onto a new street in the route. At each demarcation point, users will be offered a command to repeat, pause, continue, backup, as well as other options.

In the illustrated embodiment of the invention, the instructions and commands for a caller retrieving directions to a destination location are shown in FIGS. **4** through **12**. Callers are urged to pull off the roadway before calling the system for assistance. However, it should be anticipated that callers may access the system while driving (against their better judgment), often while simultaneously attempting operate a motor vehicle and not have their hands free for manipulating a keypad. Thus, while receiving directions it is desirable that the caller can control the playback of directions with vocabulary of voice recognized verbal commands using the speech recognition described herein.

FIGS. **4** to **12** show flow charts of the possible menu selections at various points in the interactive user interface menu.

Referring to FIG. **4**, shown is a flow chart of an introductory statement played to a user allowing the user to obtain further instructions. At step **102**, the users may verbally request "instructions" or press the star key "*" followed by the "0" key to hear instructions about using the system. The interactive user interface includes speech recognition to recognize the users'verbally spoken commands to initiate the appropriate menu selection. The speech recognition is programmed to recognize a number of spoken key words that correspond to various menu selections. At step **104**, the user may select the option of being transferred to a live operator by speaking a key word such as "operator" or pressing the "0" key. At step **106**, pause of the playback of the system can be selected by saying "pause" or entering the "5" key. At this particular menu level, selecting the pause feature will pause the system for about 2 seconds. Playback may also be resumed by entering any key selection. At step **108**, the information, which may include the route instructions, are played to the user. Step **109** represents the route instructions being played to the user.

Shown in FIG. **5** are several possible menu selections available to users while the route instructions are being played such as at step **109**. As shown in FIG. **5**, users can start the playback of the retrieved directions over from the beginning by stating "start over" or by pressing the "1" key on the keypad at step **110**. After hearing each step in the directions, the user can say "continue" or press the "2" key to hear the next step of the route instructions at step **112**. At step **114**, the user can pause the playback of the directions by stating "pause" or by pressing the "5" key. Playback can be resume by saying "resume" or by pressing the "5" key again. The menu selections available from the pause features will be described in more detail below.

Referring to FIG. **6**, shown are the available menu commands from the pause feature selected at step **114** of FIG. **5**. In this illustrative embodiment, a message indicating the instructions have been paused is played every 30 seconds. At step **130**, the playback can be paused for up to 5 minutes. At step **132**, the playback of the instructions is resumed by requesting "resume" or entering the "5" key. At step **134**, the number of invalid verbal or key entries are counted and maintained. In the pause menu of FIG. **5**, the "resume" or "5" key are the only valid entries. All other key entries (1, 2, 3, 4, 6, 7, 8, 9, 0, *, #) or verbal commands are invalid. If speech that cannot be interpreted as valid commands are detected, the pause message is played no more than every 10 seconds. Invalid entries are indicated to the caller. At step **136**, if the number of invalid entries during the pause feature exceeds 3 consecutive errors, the user may be having some difficulty with the system and is transferred to an operator console for assistance.

Referring again to FIG. **5**, at step **116**, requesting "spelling" or entering the "3" key causes the current step of the route instructions to be repeated in a spelling mode by the user. The spelling mode spells out the name of the streets contained in the directions. For example, the instructions "turn right on Elm" would also include the instruction "Elm is spelled E, L, M." By providing the spelling of street names, the spelling mode makes the streets easier to find and the route instructions easier for a user to follow.

At step **118**, saying "back up" or pressing the "7" key allows the user to back up to the previous step in the directions.

At step **120**, saying "repeat" or by pressing the "8" key cause the current direction step to be repeated. At step **122**, the directions can be skipped ahead one step by requesting "skip ahead" or by pressing 9. At step **124**, operator assistance can be obtained by requesting "operator" or by pressing the "0" key. At step **126**, the playback of the route directions can be paused and the available instructions menu can be played by requesting "instructions" or by pressing the star key * followed by zero.

After each step of the route instructions, if no command is given within a timeout period, the system will continue automatically to the next route instruction step. Preferably, the timeout is configurable by the system but is typically set to a range of 2–4 seconds. In addition, each step of the route instructions may be proceeded by a step number identifying that step of the route directions (e.g., Step X: Turn <direction> on <street>).

After each step of the directions at step **128**, a determination is made whether the end of the route instructions or directions has been reached (i.e., the last step) or there are additional steps in the route instructions remaining to reach the destination. Preferably, the last step of the route instructions will indicate total trip distance and need not be preceded by a step number.

At step **130**, if there are additional route instruction steps remaining, the system is in a post step state to play the remaining direction steps. At step **132**, if the end of the route instructions have been reached, the system is in a post step state ready to proceed to the next step of the directions.

Referring now to FIG. **7**, shown are the commands available at step **130** of FIG. **5** after each step of the directions have been played. As shown in FIG. **7**, the playback of the route instruction can be started over from the beginning by stating "start over" or by pressing the "1" key on the keypad at step **140**. At step **142**, the user can say "continue" or press the "2" key to proceed to hear the next step of the route instructions. At step **144**, the user can pause the playback of the directions by requesting "pause" or by pressing the "5" key. Playback can be resumed by requesting "resume" or by pressing the "5" key again. The menu selections available from the pause features are those previously shown in FIG. **6**.

At step **146**, the current step of the route instructions is repeated in a spelling mode. The spelling mode spells out the name of the streets in the route instructions as described at step **116** of FIG. **5**.

At step **148**, saying "back up" or pressing the "7" key allows the user to back up to the previous step in the route instructions.

At step **150**, the current step of the route instructions can be repeated by saying "repeat" or by pressing 8. At step **152**, the directions can be skipped ahead one step by saying "skip ahead" or by pressing 9. At step **154**, operator assistance can be obtained by requesting "operator" or by pressing the "0" key. At step **156**, the playback can be paused and the available instructions menu can be played by requesting "instructions" or by pressing the star key * followed by zero.

At steps **158** and **160**, unrecognized speech commands and invalid key entries are handled. FIG. **8**, shows allowing callers 3 chances to enter a valid selection. After an invalid selection at step **160**, callers will be informed of their invalid selection and given an opportunity to select another option at step **162**. At step **164**, the number of consecutive invalid selections are maintained. At step **166**, after 3 invalid selections, users will be transferred to a live operator for assistance. Likewise, users will have 3 chances to speak a valid command or be transferred to a live operator. Preferably, the live operator will have access to the user's session including his requests for information and the received responses. FIGS. **9** through **12** show an illustrative embodiment of a menu command structure for handling unrecognized commands.

FIGS. **9–11** shows exemplary error handling for unrecognized commands received from the user. The exemplary embodiment of the error handling shown in FIG. **9** allows 3 consecutive unrecognized commands or errors before sending the user to a live operator **170** for assistance. After each unrecognized command, the user may be given additional assistance as shown in FIGS. **10** and **11**.

FIG. **12** shows the menu commands at the post directions of step **132** of FIG. **5**. After the route directions have been played, the available commands are played back to the user at step **170**. At step **172**, requesting "start over" or entering a "1" key starts the direction over at the beginning. At step **174**, requesting "repeat" or entering the "8" key repeats the current step direction. At step **176**, requesting "back up" or entering the "7" key goes back to the beginning of the previous step and continues the playback of the route directions. At step **178** the available instructions menu can be played by requesting "instructions" or by pressing the star key * followed by zero. At step **180**, operator assistance can be obtained by requesting "operator" or by pressing the "0" key. At steps **182** and **184**, invalid entries and unrecognized commands are handled as previously described.

The present embodiment may also be realized as a method of providing information over a telephone line. The method may be embodied in the form of executable code running on a processing system with a high-speed Central Processing Unit ("CPU") **48** and a memory system **52**. In accordance with the practices of persons skilled in the art of computer programming, the present invention is described below with reference to acts and symbolic representations of operations that are performed by the computer processing system, unless indicated otherwise. Such acts and operations are sometimes referred to as being "computer-executed", or "CPU executed."

It will be appreciated that any symbolically represented operations or acts described include the manipulation of electrical signals by the CPU. The electrical system represent data bits which cause a resulting transformation or reduction of the electrical signal representation, and the maintenance of data bits at memory locations in the memory system to thereby reconfigure or otherwise alter the CPU's operation, as well as other processing of signals. The memory locations where data bits are maintained also include physical locations that have particular electrical, magnetic, optical, or organic properties corresponding to the stored data bits.

The data bits may also be maintained on a computer readable medium including magnetic disks, optical disks, organic disks, and any other volatile or (e.g., Random Access memory ("RAM")) non-volatile (e.g., Read Only Memory ("ROM")) storage system readable by the CPU. The computer readable medium includes cooperating or interconnected computer readable media, which exist exclusively on a processing system or is distributed among multiple interconnected processing systems that may be local or remote to the processing system.

The present embodiment preferably includes a software module as a set of computer executable software instructions. The software instructions are executed as data bits by the CPU with a computer memory system. The software instructions cause CPU to access the gain lookup table preferably stored in data memory. In an alternate embodiment, the software instructions may evaluate a function to calculate the appropriate amplification gain without requiring an access to a gain lookup table stored in memory. The executable code may implement, for example, the methods described in further detail below.

Referring to FIG. **13**, the starting location, usually the current location of the caller, can be determined at step **200** using an ALI technology. The ALI can identify the location of the caller implementing any of the ALI technologies previously described. The caller's location can then be used to populate the call detail, which is passed onto to the operator console to be available for the operator during the transaction with the caller.

At step **202**, the starting location determined in step **200** can be used with a selected destination location and a route between the two locations can be mapped. In an illustrative embodiment, a database can provide the geographical locations of the starting and destination locations. The route is mapped between the geographical starting and destination locations with a software program. Preferably, a route database is used to determine the route between the two starting and destination locations as previously described above. At step **204**, the step-by-step street driving route instructions are determined to provide specific directions from the staring location to the destination location. The route instructions can be determined according using a routing database as previously described.

At step **206**, the step-by-step route instructions are segmented and demarcated between each step of the instructions. For example, at each point in the instructions where the route instruction instructs the caller to changes from one road to another i.e., "turn right on ELM," "turn right on Main Street." The segmentation of the route instructions provides convenient points for the interactive user interface to stop, pause, and repeat the driving instructions. Use of the demarcated route instructions to provide a convenient mechanism for the call to control the playback of route driving instructions is described previously above.

At step **208**, the interactive user interface communicates the demarcated route instructions. The interactive user interface provides a convenient interface to allow the user to receive route instructions over the telephone. The user interface preferably uses the demarcated route instructions to allow a user to control the playback of the instructions as described in reference to FIGS. **4–12**.

The present embodiment preferably includes logic as a computer executable software instructions. The software can be adapted to be executed by any general purpose Computer Processing Unit ("CPU") or microprocessor controlling the operation of the system. Although the illustrative system uses an IBM RISC 6000 computer system may other computer systems/microprocessors are suitable for implementing the described system and methods. The microprocessor executes software that can be programmed by those of skill in the art to provide the desired functionality as described in the included Figures. The software can be represent as a sequence of binary bits maintained on a computer readable

medium including magnetic disks, optical disks, organic disks, and any other volatile or (e.g., Random Access memory ("RAM")) non-volatile firmware (e.g., Read Only Memory ("ROM")) storage system readable by the CPU. The memory locations where data bits are maintained also include physical locations that have particular electrical, magnetic, optical, or organic properties corresponding to the stored data bits. The software instructions are executed as data bits by the CPU with a memory system causing a transformation of the electrical signal representation, and the maintenance of data bits at memory locations in the memory system to thereby reconfigure or otherwise alter the system's operation.

The illustrative embodiment improves the usability of the system and improves the productivity of the operator console position. The automatic location identification a eliminates the need for callers to identify their location when calling into the system for assistance. The automatic location identification also speeds the handling of calls at the operator console by eliminating the step of querying the caller for his location. The interactive user interface allows the user to more easily obtain the route instructions by providing a mechanism to start and stop the directions at convenient points. The interactive user interface also improves the productivity of the operator console by allowing the operator to pass the caller off to the interactive user interface and move on to handle the next caller.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed. Numerous modifications and variations are possible. For example, the steps of the flow diagrams may be taken in sequences other than those described and the invention may be practiced with more or fewer elements than those shown. It is intended that the foregoing detailed description be regarded as illustrative rather than limiting. It is the following claims, including all equivalents, which are intended to define the scope of this invention.

We claim:

1. A system for providing a telephone caller driving route instructions from a calling location to a destination location comprising:

an automatic location identification for automatically identifying the calling location from where the telephone caller originated the telephone call;

a database for mapping route instructions from the calling location to the destination location, wherein the route instructions are coded at demarcated points to allow for manipulation of the route instructions during playback; and

an interactive user interface accessible over a telephone call for communicating route instructions to the telephone caller, wherein the interactive user interface provides a user with commands at each demarcated point to manipulate, during playing, the playback of the route instructions.

2. The system of claim 1 wherein the automatic location identification for identifying the calling location further comprises:

automatic number identification for identifying the calling party telephone number; and

a telephone number database for determining the address of the calling party telephone number.

3. The system of claim 2 wherein the telephone number database comprises a name, address and telephone number database (NATD) containing geo-code information identifying the geographic location of the telephone caller.

4. The system of claim 3 wherein the geo-code information identifying the geographical location comprises longitude and latitude coordinates.

5. The system of claim 1 wherein the route instructions comprise street driving instructions between the calling location and the destination location.

6. The system of claim 1 wherein the route instructions are step-by-step driving instructions which have been demarcated at each step of the instructions.

7. The system of claim 1 wherein the automatic location identification identifies the caller location comprising a dedicated radio-location network.

8. The system of claim 1 wherein the automatic location identification identifies the caller location comprising a GPS location system.

9. The system of claim 1 the interactive user interface comprising:

a gateway for translating the route instructions to an audio box for speech synthesis; and

an audio box for receiving the translated route instructions and verbalizing the route instructions.

10. A system for providing a telephone caller driving instructions from a calling location to a destination location comprising:

an automatic location identification for automatically identifying the calling location from where the telephone caller originated the telephone call, comprising:

automatic number identification for identifying the calling party telephone number; and

a telephone number database for determining the address of the calling party telephone number;

a database for mapping route instructions from the calling location to the destination location, wherein the route instructions are coded at demarcated points to allow for manipulation of the route instructions during playback; and

an interactive user interface accessible over a telephone call for communicating route instructions to the telephone caller, wherein the interactive user interface provides a user commands at each demarcated point to manipulate, during playing, the playback of the route instructions, comprising:

a gateway for translating the route instructions to an audio box for speech synthesis; and

an audio box for receiving the translated route instructions and verbalizing the route instructions.

11. A method of providing driving instructions between a starting location and destination location to a telephone caller comprising the steps of:

locating the starting location using an automatic location identification technology;

mapping a driving route between the starting location and the destination location;

determining step-by-step driving instructions in accordance with the step of mapping the driving route;

coding the driving instructions at each step of the directions into segments, wherein the coded driving instructions can be manipulated during playback by commands provided to a user at each segment using an interactive user interface; and

communicating the driving instructions over a telephone line with an interactive user interface adapted to communicate the coded driving instructions.

12. The method of claim 11 wherein the interactive user interface comprises the capability of pausing the instructions at a coded segment.

13. The method of claim 11 wherein the interactive user interface comprises the capability of repeating the segment of the instructions at a coded segment.

14. The method of claim 11 wherein the interactive user interface comprises the capability of repeating the instructions from the beginning at a coded segment.

15. A system for providing a telephone caller driving route instructions from a starting location to a destination location comprising:

a database for mapping route instructions from the starting location to the destination location, wherein the route instructions are coded at demarcated points to allow for manipulation of the route instructions during playback; and

an interactive user interface accessible over a telephone call for communicating route instructions to the telephone caller, wherein the interactive user interface provides a user with commands at each demarcated point to manipulate, during playing, the playback of the route instruction.

16. The system of claim 15 wherein the commands are activated by a telephone caller's voice.

17. The system of claim 15 wherein the commands are activated by a depressing a key from the DTMF keypad.

18. The system of claim 15 wherein the route instructions comprise street driving instructions between the starting location and the destination location.

19. The system of claim 15 wherein the route instructions are step-by-step driving instructions which have been demarcated at each step of the instructions.

20. The system of claim 15 the interactive user interface comprising:

a gateway for translating the route instructions; and

an audio box for receiving the translated route instructions and verbalizing the route instructions.

21. A system for providing a telephone caller driving route instructions from a starting location to a destination location comprising:

a database for mapping route instructions from the starting location to the destination location, wherein the route instructions are coded at demarcated points to allow for manipulation of the route instructions during playback;

an interactive user interface accessible over a telephone call for communicating route instructions to the telephone caller, wherein the interactive user interface provides a user with commands at each demarcation point to manipulate, during playing, the playback of the route instructions;

a gateway for translating the route instructions to an audio box for speech synthesis; and

an audio box for receiving the translated route instructions and verbalizing the route instructions.

* * * * *

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United States Patent [19]

Trautman

[11] Patent Number: 5,121,470

[45] Date of Patent: Jun. 9, 1992

[54] AUTOMATED INTERACTIVE RECORD SYSTEM

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[73] Assignee: Intellimetrics Instrument Corporation, Billerica, Mass.

[21] Appl. No.: 473,651

[22] Filed: Feb. 1, 1990

[51] Int. Cl.[5] G06F 15/20

[52] U.S. Cl. 395/140; 395/155

[58] Field of Search 364/518, 521, 413.01, 364/413.02, 413.06; 395/140, 155, 156, 160, 161

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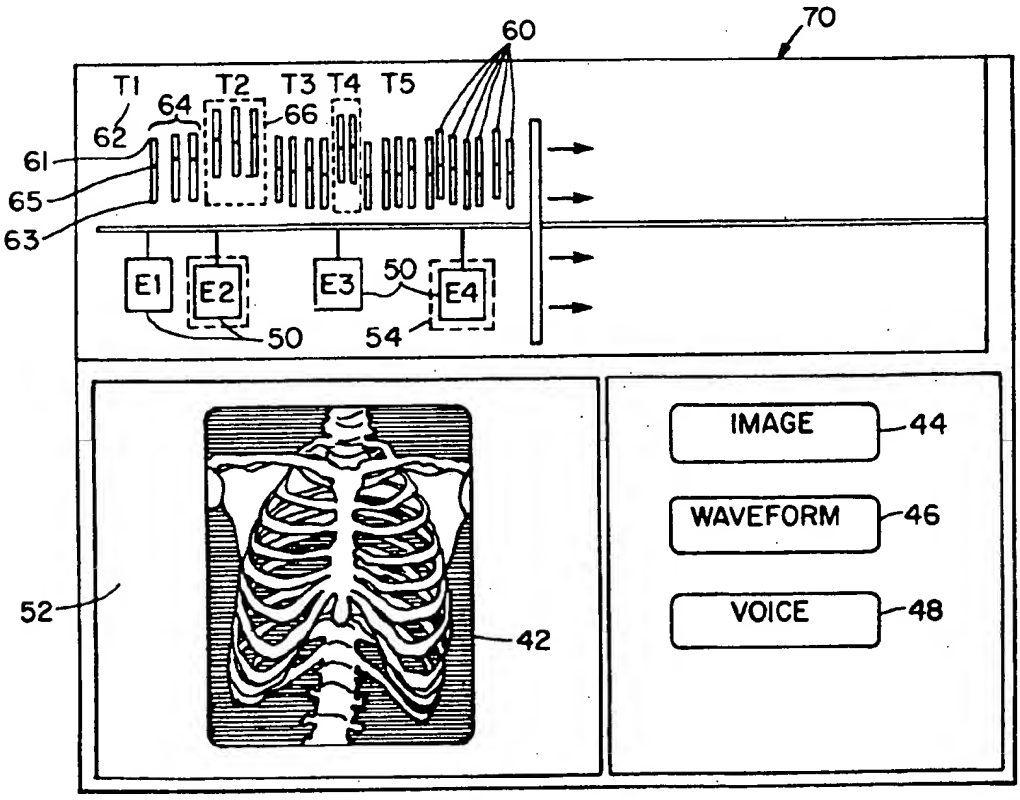
Primary Examiner—Heather R. Herndon

Attorney, Agent, or Firm—Iandiorio & Dingman

[57] ABSTRACT

An automated interactive record system for automatically indexing a set of data obtained from a number of internal and external input sources. A set of data is organized along at least one indexing dimension. Specific data events are identified from the set of data according to predetermined methods. An index of data objects associated with the specific data events is then established. The index of data objects is then displayed along the indexing dimension and actuators are defined for manipulating the data objects that are associated with specific data events.

34 Claims, 10 Drawing Sheets



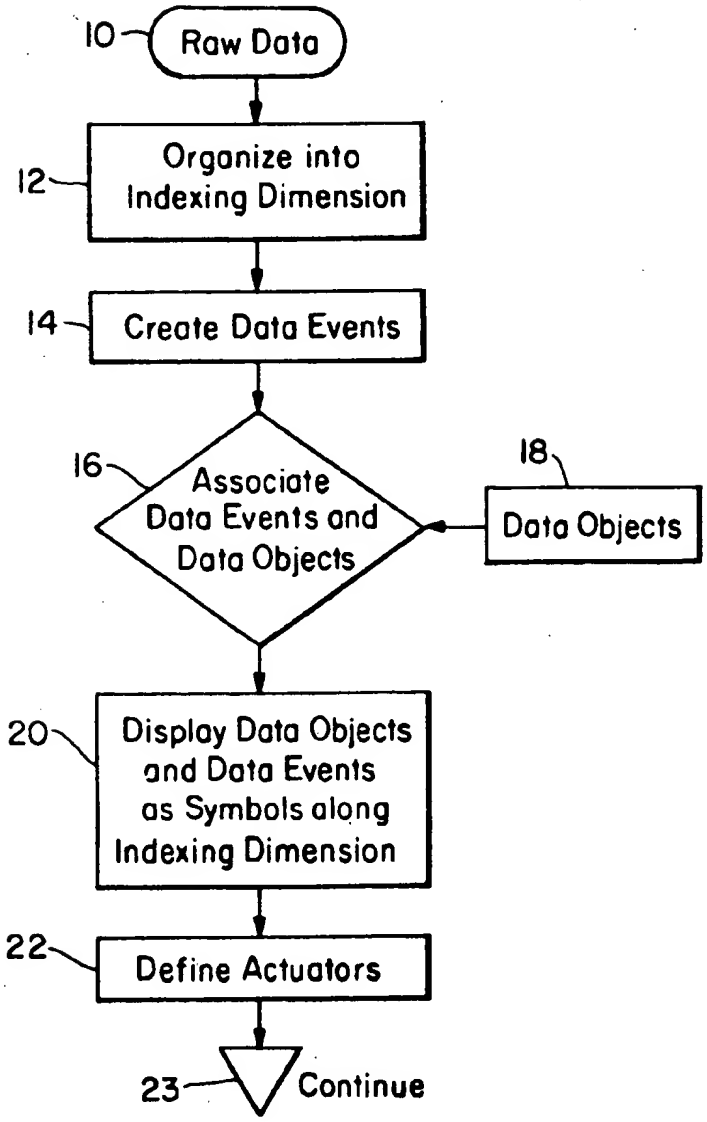


Fig 1

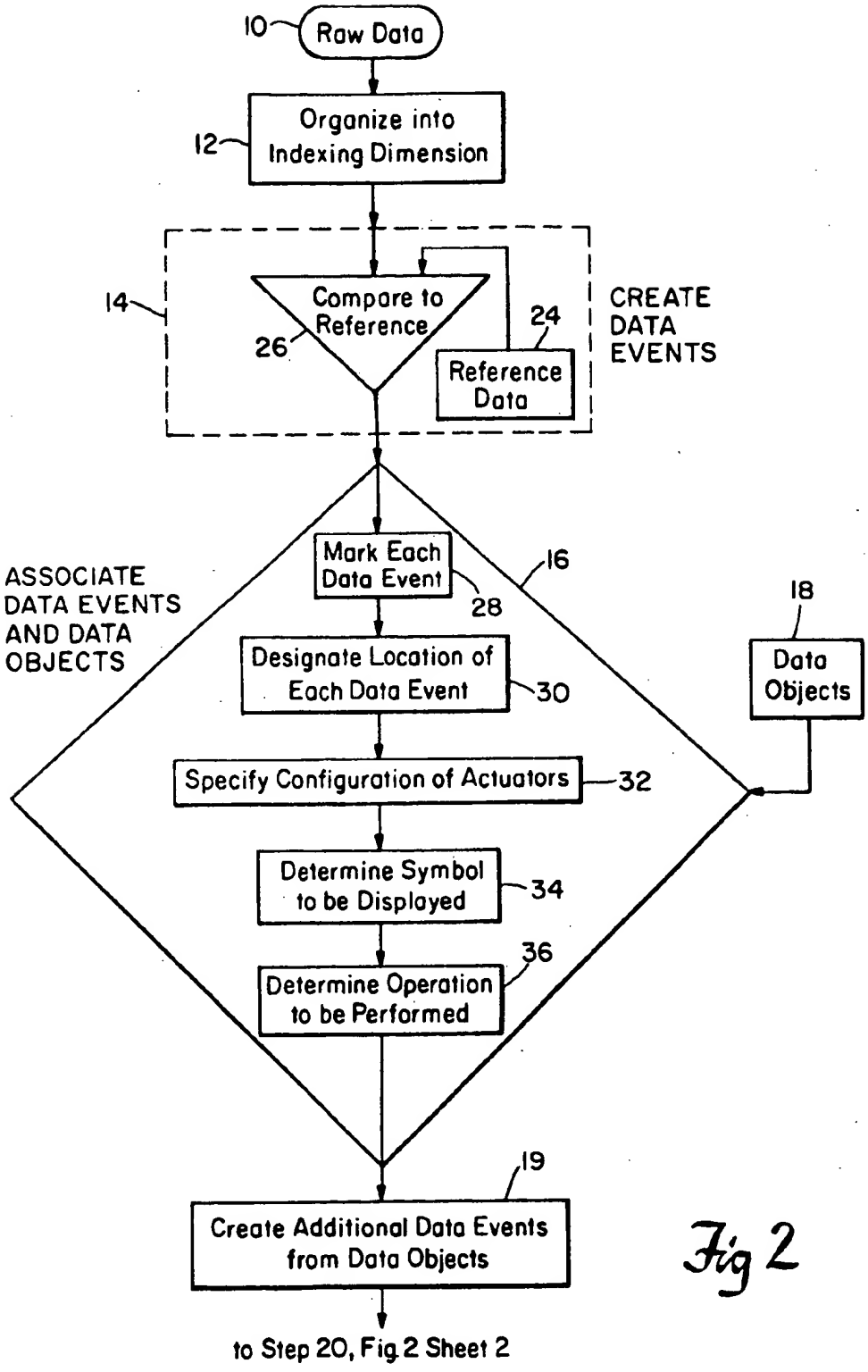

10
Raw Data
12
Organize into Indexing Dimension
14
Compare to Reference
26
24
Reference Data
CREATE DATA EVENTS
ASSOCIATE DATA EVENTS AND DATA OBJECTS
16
Mark Each Data Event
28
Designate Location of Each Data Event
30
Specify Configuration of Actuators
32
Determine Symbol to be Displayed
34
Determine Operation to be Performed
36
18
Data Objects
19
Create Additional Data Events from Data Objects
to Step 20, Fig 2 Sheet 2

Fig 2

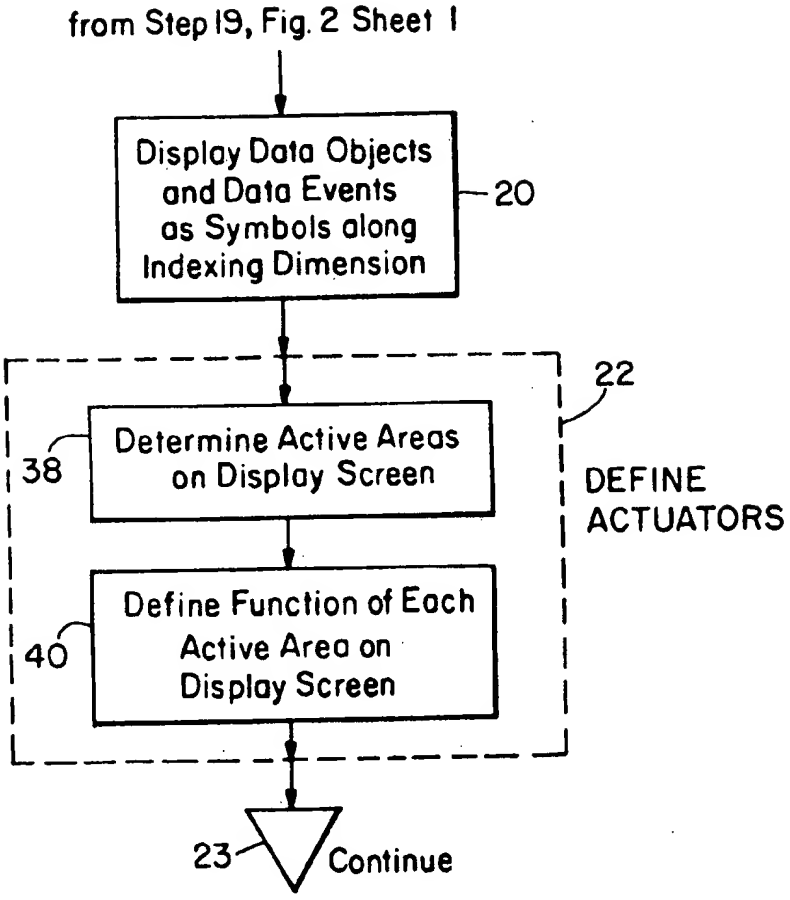

from Step 19, Fig. 2 Sheet 1
Display Data Objects and Data Events as Symbols along Indexing Dimension
20
22
38
Determine Active Areas on Display Screen
DEFINE ACTUATORS
40
Define Function of Each Active Area on Display Screen
23
Continue

Fig 2

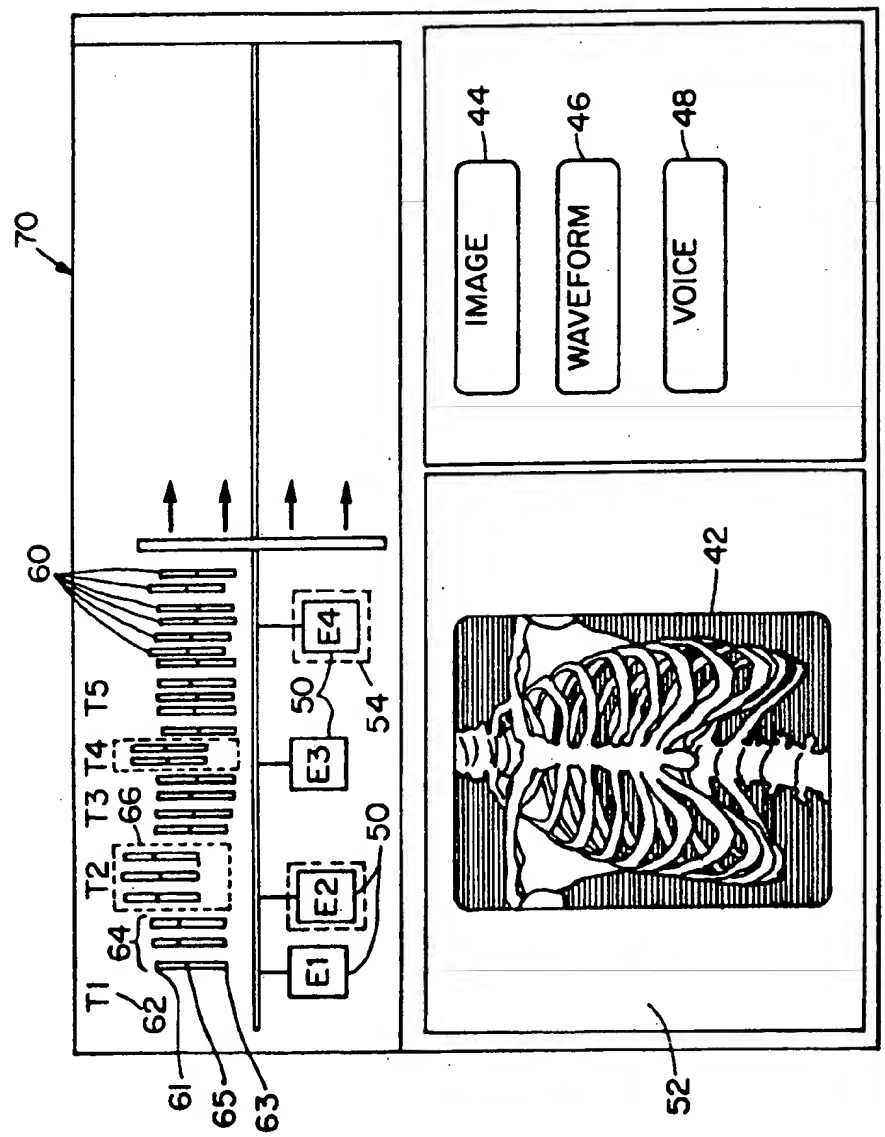

70
60
T5
T4
T3
T2
T1
66
64
62
61
65
63
E4
E3
E2
E1
50
54
IMAGE
WAVEFORM
VOICE
44
46
48
42
52

Fig. 3

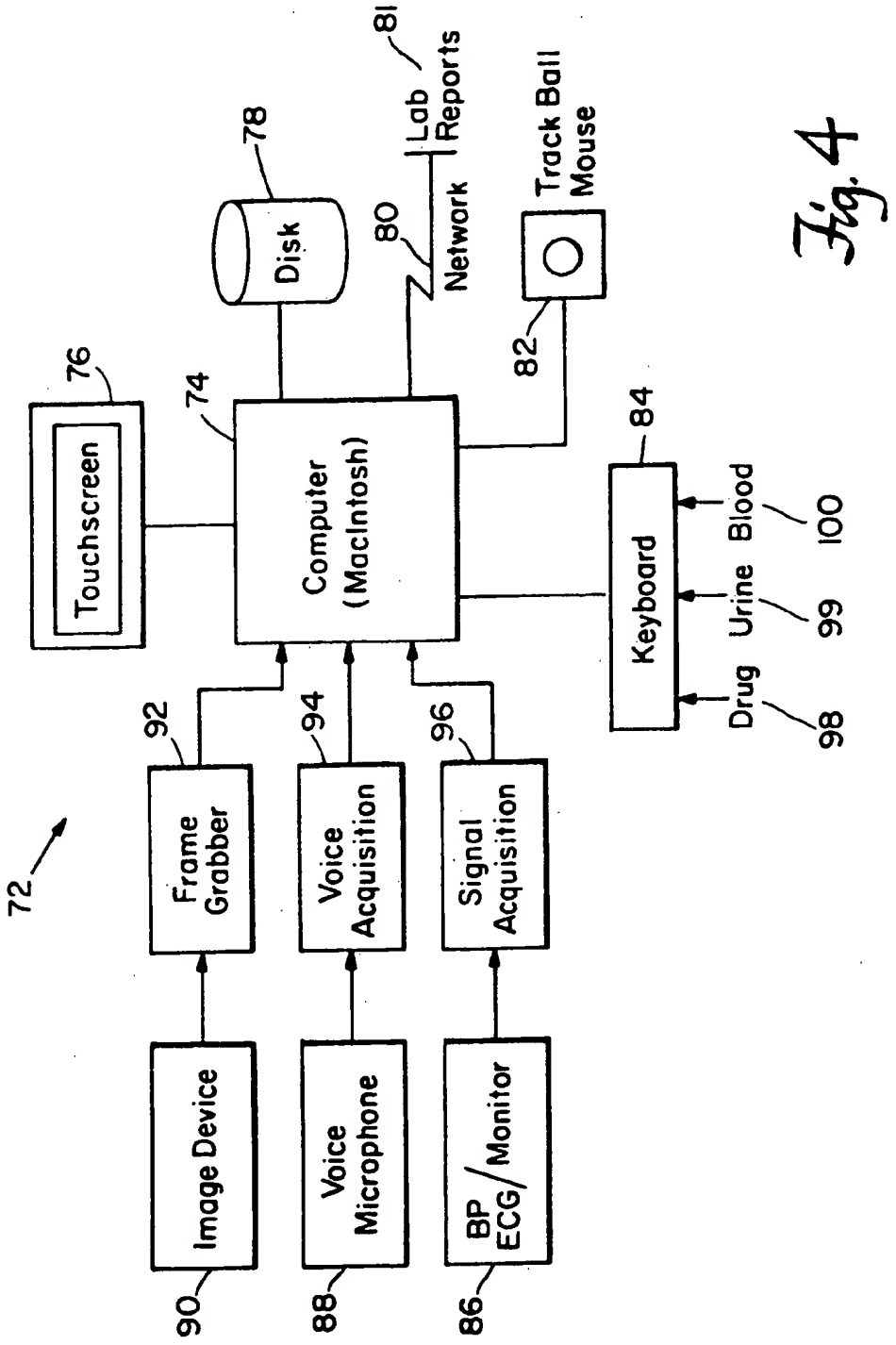

72
Frame Grabber
Voice Acquisition
Signal Acquisition
92
94
96
Image Device
Voice Microphone
BP ECG/Monitor
90
88
86
Computer (MacIntosh)
74
Touchscreen
76
Disk
78
Network
80
Lab Reports
81
Track Ball Mouse
82
Keyboard
84
Blood
100
Urine
99
Drug
98

Fig. 4

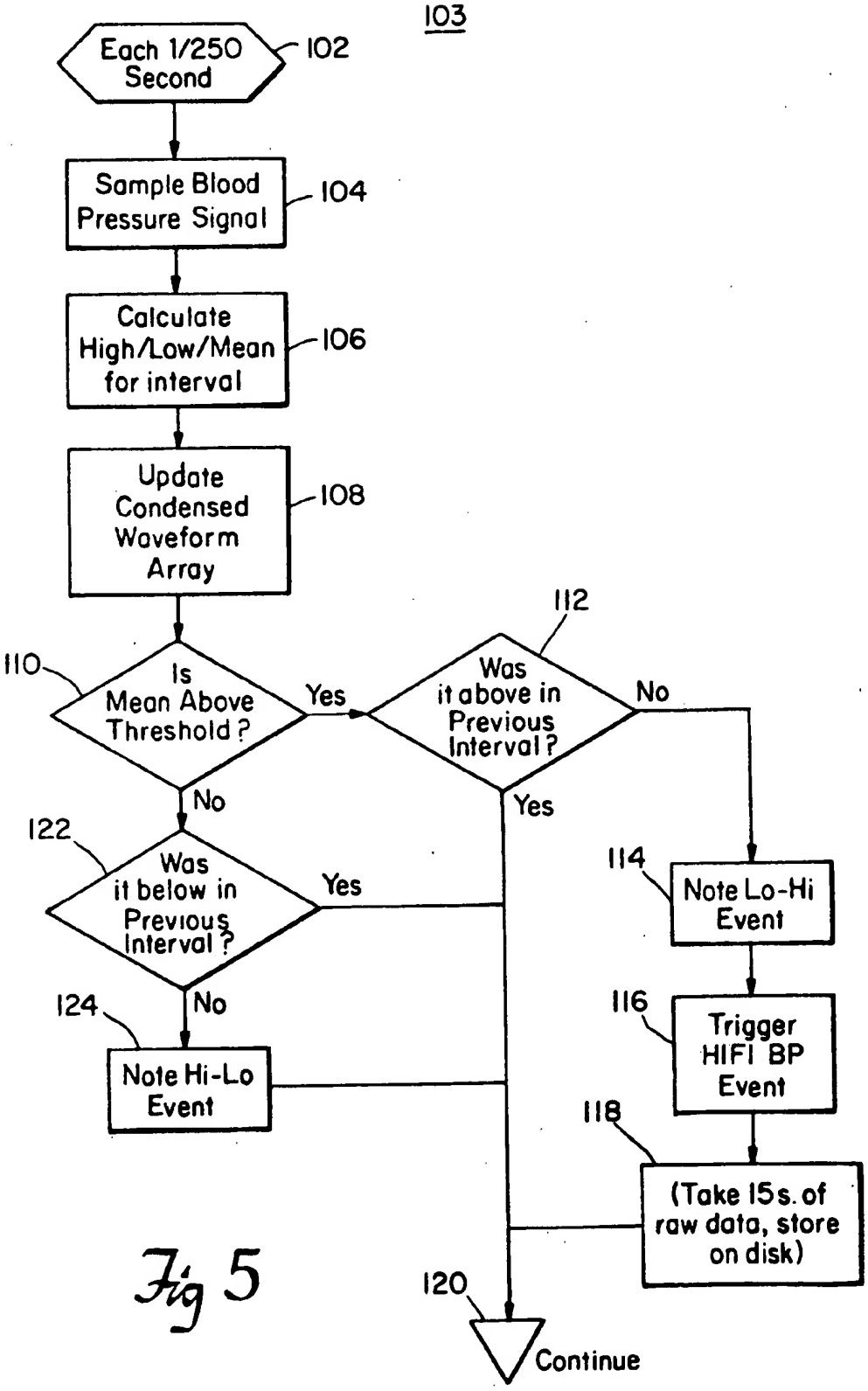

103
Each 1/250 Second
102
Sample Blood Pressure Signal
104
Calculate High/Low/Mean for interval
106
Update Condensed Waveform Array
108
110
Is Mean Above Threshold?
Yes
112
Was it above in Previous Interval?
No
Yes
No
122
Was it below in Previous Interval?
Yes
No
124
Note Hi-Lo Event
114
Note Lo-Hi Event
116
Trigger HIFI BP Event
118
(Take 15s. of raw data, store on disk)
120
Continue

Fig 5

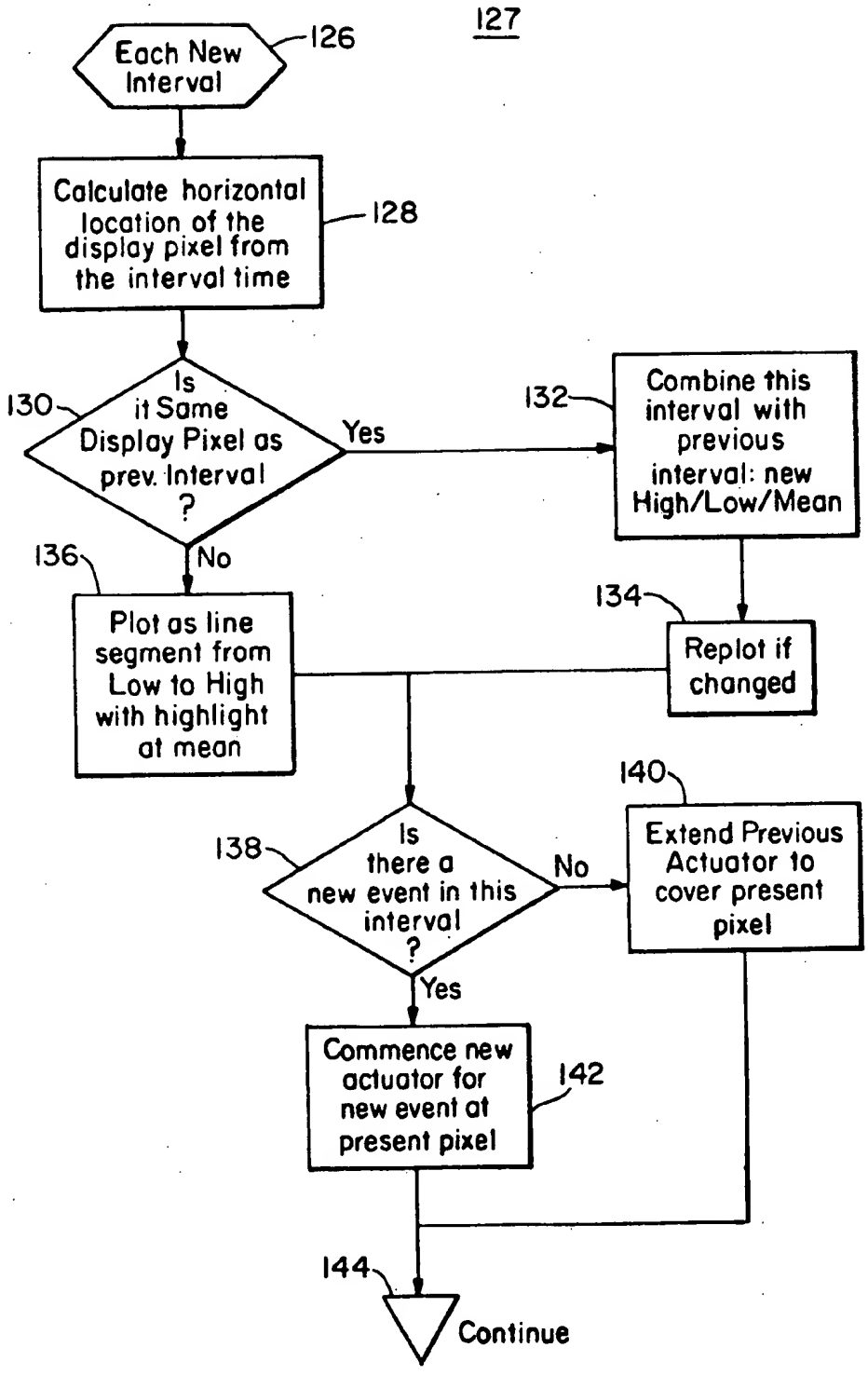

127
Each New Interval
126
Calculate horizontal location of the display pixel from the interval time
128
Is it Same Display Pixel as prev. Interval ?
130
Yes
No
Combine this interval with previous interval: new High/Low/Mean
132
Plot as line segment from Low to High with highlight at mean
136
Replot if changed
134
Is there a new event in this interval ?
138
No
Yes
Extend Previous Actuator to cover present pixel
140
Commence new actuator for new event at present pixel
142
144
Continue

Fig 6

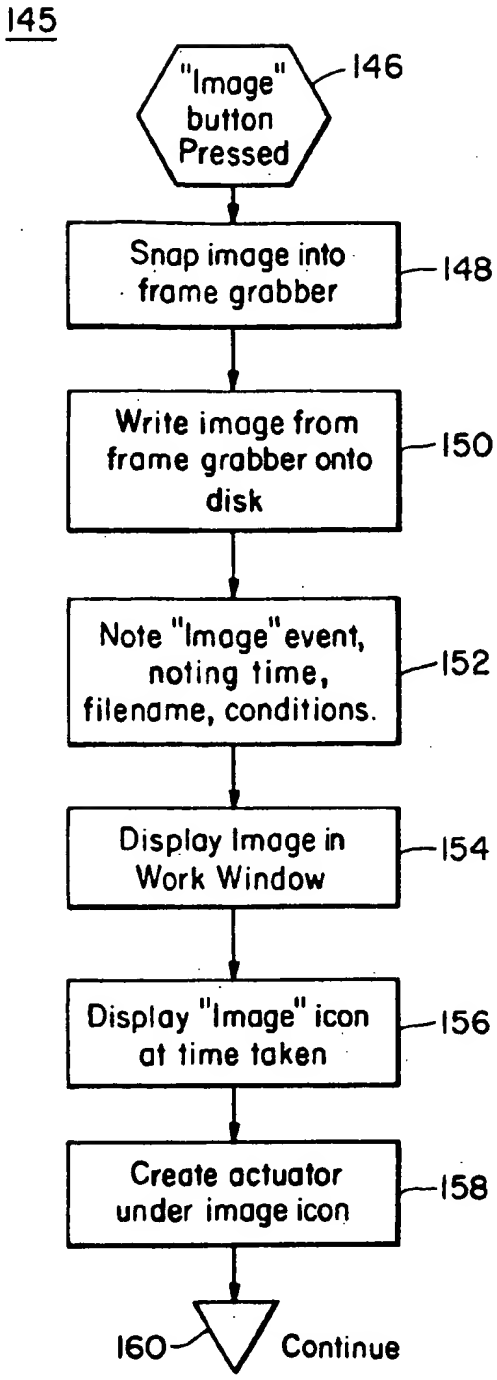

145
"Image" button Pressed
146
Snap image into frame grabber
148
Write image from frame grabber onto disk
150
Note "Image" event, noting time, filename, conditions.
152
Display Image in Work Window
154
Display "Image" icon at time taken
156
Create actuator under image icon
158
160
Continue

Fig 7

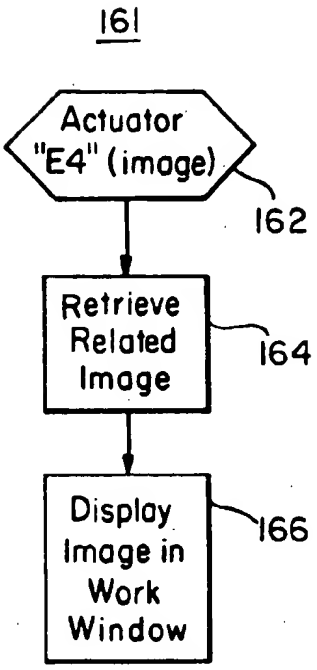

161
Actuator "E4" (image)
162
Retrieve Related Image
164
Display Image in Work Window
166

Fig 8

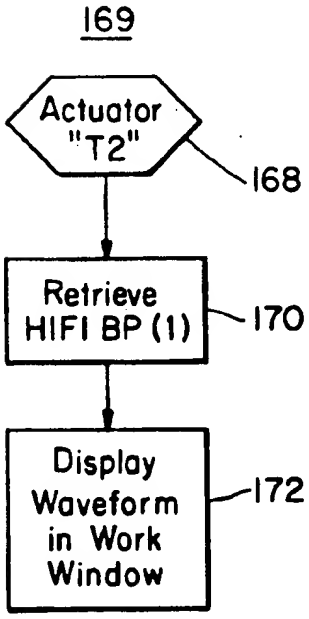

169
Actuator "T2"
168
Retrieve HIFI BP (1)
170
Display Waveform in Work Window
172

Fig. 9

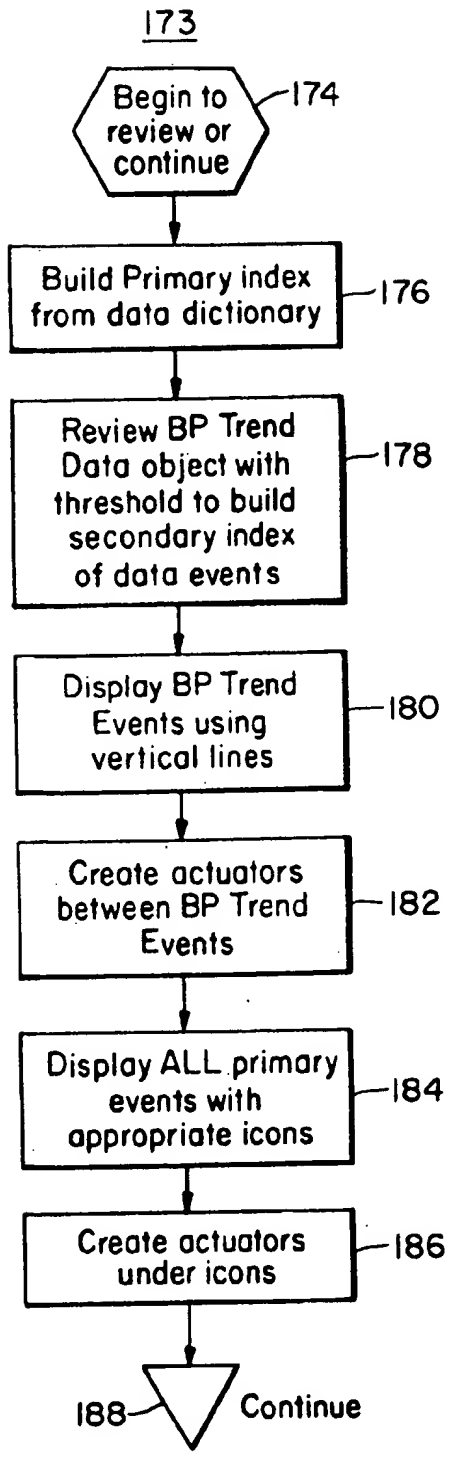

173
Begin to review or continue
174
Build Primary index from data dictionary
176
Review BP Trend Data object with threshold to build secondary index of data events
178
Display BP Trend Events using vertical lines
180
Create actuators between BP Trend Events
182
Display ALL primary events with appropriate icons
184
Create actuators under icons
186
188
Continue

Fig. 10

AUTOMATED INTERACTIVE RECORD SYSTEM

FIELD OF INVENTION

This invention relates to an automated interactive recover system, and more particularly to a system that displays data along at least one indexing dimension and allows ready access to associated data relative to some point or set of points along the dimension and the input of data to be displayed at given locations upon the dimension.

BACKGROUND OF INVENTION

In the medical care field, data on a patient's recovery or condition is often entered by hand after performing a therapeutic function or observing various monitors and measuring devices. This data is combined into a series of data collections often without easy access to any single piece of data or a method of correlating data from different places within the collection as a whole. This lack of organization and easy access makes it difficult for health care personnel to quickly identify trends and key events in the patient's condition. Further, the prospective administration of procedures, medication or tests may also prove troublesome since this type data is not generally combined or correlated with already existing monitor data that is gathered on the patient. This monitor data, however, could in fact be a necessary precondition to performing this prospective administration of care.

Even when health care personnel store patient data on a computer, it is not adequately organized and presented with respect to the overall process of monitoring condition or recovery, which is often represented by a strip chart recording of a certain vital sign. Hence, correlating other data with a given time period on the strip chart recording often proves difficult and comparing this set of data in order to reach general conclusions, once it is correlated with similar data taken at earlier intervals, proves even more troubling. In specific areas of medical care, technology is now available to monitor several parameters of the subject's condition through a computer. However, the problem with many computer monitoring systems is the continuing inability of the user to correlate the many layers of interconnected data in a manner in which the initial broad perspective of the data is not lost. This is the problem encountered with hypermedia in which, as progressively smaller concentrations of data are viewed, the large picture becomes lost, thus leading to viewer disorientation and confusion. A system is required to retain perspective with the larger view of data while concurrently allowing the viewer to delve into the layers of hypermedia. A need thus arises in medicine as well as in many other areas of process control and monitoring of nonmedical systems, to devise a method to track and correlate various data from a variety of sources, including the computer's own internal calculations with reference to a time line or similar dimension that retains a larger and lasting perspective.

SUMMARY OF INVENTION

It is therefore an object of this invention to provide a system for the automatic collection, organizing and indexing of a set of acquired signal data, or other previously stored data, and display of this index data graphically on one or more axes where the viewer maintains the ability to access or input specific data objects, relative to a point or group of points, that constitute a specific event as predefined by the system.

It is a further object of this invention to provide a system which reduces viewer confusion and disorientation by maintaining a continual display of the data shown on the axis while input or accessed data objects may be viewed independently with reference to the axis.

It is a further object of this invention to provide a system which indexes data from preexisting data bases and otherwise input data.

It is a further object of this invention to provide a system which allows the input of data from a variety of both manually, internally generated, and automatically activated sources.

It is a further object of this invention to provide a system allowing input and display of data objects in a variety of manners and representations, including textual, audio, graphical and pictorial.

It is a further object of this invention to provide a system allowing the user direct screen interaction to manipulate data.

It is a further object of this invention to provide a system which provides access to and input of data in a manner highly effective in the fields of process control, medical care and other areas requiring organization of various forms of data over a dimension.

This invention results from the realization that a truly effective data management and control system may be achieved through the combination of the two powerful independent concepts of hypermedia and indexing of data along one or more dimensions, and through a system that provides for the input of data from a variety of sources and that identifies and associates these data inputs with specific points of significance along the indexing dimension to give the viewer a clear, unconfusing, display with easy access to, and control of, data.

This invention features an automated interactive record system. This system includes means for organizing a set of data along at least one indexing dimension. There are means provided for identifying specific data events from the set of data according to predetermined methods. There are means for establishing an index of data objects associated with the specific data events. There are further means for displaying this index of data objects along the indexing dimension and means for defining actuators for manipulating the data objects indexed with specific data events.

In a preferred embodiment, the means for establishing an index of data objects may further include marker means for individually marking data events. The marker means may further include means for designating the location of data associated with specific data events, means for specifying the configuration of actuators, means for determining a symbolic representation to be displayed for a given data object, and means for designating the operation to be effected for a specific data event. The means for defining actuators may further include means for bounding interactive areas on the display screen corresponding to locations along the indexing dimension, and those means for bounding may include means for operating the actuators in response to a touching of the interactive areas and in response to a contacting of the interactive areas with a cursor. The means for displaying the index of data objects and specific data events may further include means for generating descriptive pictorial icons which are symbolic rep-

resentations of data objects and specific data events and which are associated with specific data events along the indexing dimension. The means for organizing a set of data may further include an indexing dimension, which is time. The means for identifying specific data events may include means for comparing the set of data to a reference and means for reviewing data objects to generate additional specific data events. The means for organizing this set of data may include means for graphically plotting the set of data on a display screen. This means for graphically plotting may further include means for graphically displaying the minimum, maximum and mean values of data over a given interval. Finally, the means for establishing an index of data objects may include a data object comprising at least one of a plurality of data fields including audio, visual, textual, numerical, algorithmic and graphical data.

DISCLOSURE OF PREFERRED EMBODIMENT

Other objects, features and advantages will occur to those skilled in the art from the following description of preferred embodiment and the accompanying drawings in which:

FIG. 1 is a flow chart of an interactive record system according to this invention;

FIG. 2 is a more detailed view of the flow chart of FIG. 1;

FIG. 3 is a display screen for the system generated by the system according to this invention;

FIG. 4 is a block diagram of an interactive record system according to this invention for medical applications showing various input, output and peripheral devices;

FIG. 5 is a flow chart for a specific medical application of the interactive record system according to this invention for indexing blood pressure data;

FIG. 6 is a more detailed view of the flow chart of FIG. 5 showing the formation of specific data events;

FIG. 7 is a flow chart showing the acquisition of an image by the system;

FIG. 8 is a flow chart showing the retrieval of an image through activation of a pictorial icon;

FIG. 9 is a flow chart showing the retrieval of a high fidelity blood pressure waveform data object through activation of an actuator; and

FIG. 10 is a flow chart showing the continuing operation of the system.

In FIG. 1 there is shown a flow chart of an interactive record system according to this invention in which a set of raw data 10 is organized along an indexing dimension 12. The indexing dimension may be time or a similar dimension that may be used to organize and correlate data from a variety of sources. An indexing dimension is a variable, parameter, or characteristic intrinsic to the data which is being accumulated, that is selected because of its commonality. Other examples of such variables or parameters include sex or age of hospital patients; day or month of the year; or dimensions such as length. By means of this commonality, data from a variety of sources can be organized and correlated.

Since the interactive record system according to this invention can be used in a number of applications, an indexing dimension(s) is selected for a specific application and the system is configured to use that indexing dimension(s). In the case where time is the chosen indexing dimension, the raw data is organised and correlated in chronological fashion. From this indexing dimension, specific data events 14 are created through distinguishing sets of data into given intervals. Data objects 18 from other sources are associated 16 with specific data events according to predetermined criteria. The data objects and data events are then displayed 20 relative to the indexing dimension as symbols. These symbols are located in relation to the associated specific data events allowing the viewer to clearly see the relationship between the data objects and indexed data events. Once the data objects are displayed along the indexing dimension, actuators are created 22 to allow the data objects to be manipulated. The actuator is an interactive area, generally placed around the symbol of a data object or data event, that allows the viewer to activate the underlying data contained in the data object or referenced by the data events. The data object may be one of a variety of multimedia collections of data including pictorial, graphical, audio, textual or numerical data. The data object or data event as displayed may also prompt the viewer for further interaction and input.

The interactive record system of FIG. 1 is shown in a more detailed flow chart in FIG. 2 in which the creation of data events 14 from an index of data along a dimension is accomplished through the comparison 26 of the indexed data with reference data 24. Data objects 18 are then associated 16 with data events. This is accomplished by marking 28 each data event to distinguish it from others and make it uniquely identifiable. Then, a location is designated 30 for each data event along the indexing dimension. The configuration of the actuators for each data event is then specified 32. The symbol to be displayed, if any, in relation to a given data event for a data object is then determined 34. Finally, the operation to be performed for each data object is determined 36. The operation performed for a data object may include the creation of additional data events 19. Data objects are reviewed and algorithmic data is retrieved and acted upon. These algorithms may specify new criteria or locations for data events which will then be noted by the system. Data objects and data events are then displayed 20 as described in FIG. 1 and actuators are defined 22. Defining of actuators is accomplished by determining the boundaries of active areas on the display screen 38 in which a given form of contact will cause an operation, and then by defining the exact function to be performed 40 for each of these active areas upon activating them.

FIG. 3 shows a specific example of a display screen for the system disclosed. An indexing dimension display 70 is shown along the top of the screen The upper half of this indexing dimension contains vertical line plots of data trends 60 which represent the maximum 61, minimum 63 and mean 65 values of data sampled over a given interval. This interval may represent the time of input. The dimension in this example plots continually from left to right.

The bottom half of the dimension display 70 contains pictorial icons 50 representative of data objects and data events and placed below and relative to data events with which the system has associated them. A data event in this example is represented by a grouping 64 of vertical line trends 60 that are all valued within a certain predetermined threshold level. In this example, groupings appearing beyond predetermined threshold levels form one basis for the creation of new data events.

A dotted line 66 appears around the trends comprising a data event. This dotted line is a representation of

an actuator. This actuator is an unseen interactive area which, when contacted either by physical or cursor touch, will operate to display predetermined associated data objects. Similar active areas **54** exist for each of the pictorial icons **50**, which, when contacted, carry out a predetermined function.

The bottom half of the display screen **52** carries a work display window, in which the contents of given data objects may be viewed or manipulated. In this particular example a pictorial data object is revealed.

The other part (right half) of bottom half of the display screen contains a series of "buttons" which in this particular example allow input of an image **44**, a waveform **46** and voice **48** to form data objects. Means for other types of input may also be provided.

Block diagram **72**, FIG. **4**, discloses a specific embodiment of the system in which a computer **74** for operating the system is provided. This computer may be an Apple Macintosh model. Data is stored on and retrieved from a disk unit **78**. A touch-sensitive interactive screen **76** may be provided for direct, physical, user interaction with the data displayed. A mouse unit **82** is also provided in order to position a cursor on the interactive screen.

A keyboard **84** is provided for data entry and manipulation. In this embodiment medical information on drug **98**, urine **99** and blood **100** data is input via this keyboard.

Further data, such as lab reports **81**, may be accessed via a network **80** linking other data bases.

Data may also be input to the system to form data objects through a number of peripheral devices. Visual images may be input via an imaging device **90** which, through use of a frame grabber **91**, creates a digitized image for storage as data in the system. Voice and similar audio inputs may be stored as data through use of a microphone **88** and voice acquisition unit **94**. Various monitoring signals may also be stored by connecting the monitor **86**, which in this example reads blood pressure or electrocardiogram, to a signal acquisition unit **96**. Other forms of data may further be input using the proper devices and systems to create data readable by the system.

Flow chart **103**, FIG. **5**, constructs blood pressure trend data arrays in a specific medical example. A sample rate of one sampling each 1/250th of a second **102** is chosen in which the blood pressure signal from a monitor is read **104**. The ongoing high, low and mean values for each data sampling interval (in this example, each five seconds) is calculated **106** from the signal each time a new sample is read. A condensed waveform of this signal is then updated **108** with the new piece of data. The system then determines if the latest mean value for the interval is above a predetermined threshold **110**. If not, the system then determines whether the stored mean for the previous interval was below the threshold **122**. If the previous interval was not below the threshold then the current interval is noted as an event from high to low **124**. The system then continues by returning to the next data sample and repeating the routine **120**. If the mean of the current interval is found to be above the threshold **110**, then the system will determine whether it was above the threshold in the previous interval **112**. If not, then the system notes an event of low to high value **114**. The system then triggers a high fidelity blood pressure waveform event **116** in which fifteen seconds of raw blood pressure monitor data is taken by the system to be stored on a disk. The system then continues by returning to the next sample **120**. Finally, if the system determines that the current mean is above the threshold **110** and the previous interval's mean was also above the threshold **112** then the system finds no event and simply continues **120** to the next sample.

Flow chart **127**, FIG. **6**, updates the indexing dimension display and actuator location. When the system determines the beginning of a new data sampling interval **126** it calculates the horizontal location of the display screen interval using the interval's dimensional value, in this example its time value **128**. The system then determines whether the display screen pixel is at the same location as that for the previous interval **130** since several intervals may be condensed into one pixel. If it is not the same pixel, then a new line segment from high to low with a highlighted mean value is plotted **136**. If the pixel, however, is the same as that in the previous interval, then the system combines the previous and current interval and calculates a new combined high, low and mean value **132** which it replots **134** within that pixel space if necessary. Given either a new pixel or not, the system then determines whether there is a new event **138** within the interval from the notation of events as described in FIG. **5**. If no new event has occurred, the actuator surrounding the plotted trends is continued to include the current pixel **140**. The system then continues **144** through the routine again upon a new interval. If, however, the system determines that a new event has been noted in this interval it begins a new actuator with the present pixel **142**. This new actuator activates any data objects associated with the new event. At this point the system continues **144** to the next interval.

Flow chart **145**, FIG. **7**, enters data by viewer activation of a button. In this example an image taking button **44** as depicted in FIG. **3** is activated **146**. The activation of this button instructs the system to activate the frame grabber **148** which digitizes an instantaneous image input by an imaging device such as a video camera. This image data is then written onto a disk for storage **150**. The image data is marked as an event with appropriate categorizations **152**, in this example, time of input, file name and the prevailing conditions. The image is then displayed by the system in the work window **42** as depicted in FIG. **3**. A pictorial icon of the image is then created and displayed **156** relative to the indexing dimension, in this example time of creation. Such an icon **50** is depicted in FIG. **3**. An actuator **54** is then created **158**, as depicted in FIG. **3**, around the pictorial icon to allow future access of the data of the image. The system then continues **160** awaiting the next input instruction.

Flow chart **161**, FIG. **8**, describes the retrieval of data through the operation of an actuator placed around a pictorial icon. An actuator placed around a pictorial icon is activated **162** by interacting with the screen either by a physical touch of the active area or through use of a cursor. Activation of the icon serves to retrieve the data object into system memory **164**, in this example a stored image. The system then displays this image in the work window **166**.

Flow chart **169**, FIG. **9**, similar to the method for retrieving data from an icon, shows the retrieval of trend event related data through the activation of a trend event located actuator **66** as depicted in FIG. **3**.

An actuator located around a group of trends on the indexing dimension comprising a trend event is operated **168** by user interaction with the display screen,

either through physical touch or cursor contact. This actuator activation causes the system to retrieve a related data object 170, in this example high-fidelity waveform data. This waveform is then displayed in the work window 172.

Finally, flow chart 173, FIG. 10, describes the continuing operation of the system. The system will either review previous collected data or continue building in new data 174. An initial dictionary of new data is indexed into a primary index of trend data events 176. These trend data events then form the basis for the creation of trend data objects. The data objects are, in turn, reviewed to build a secondary index of data events based upon the information present in the data objects 178, in this example, blood pressure waveform data objects. Trend events are then displayed by the system using vertical line plots 180. Actuators are then created for each trend event to retrieve associated data objects 182. All primary events, including those generated from data objects, are then displayed using predetermined pictorial icons which describe the type of underlying events 184. Actuators are then created to activate these pictorial icons in order to retrieve the underlying data objects represented by the icons. Finally, the system returns to repeat this process.

Although specific features of the invention are shown in some drawings and not others, this is for convenience only as each feature may be combined with any or all of the other features in accordance with the invention.

Other embodiments will occur to those skilled in the art and are within the following claims:

What is claimed is:

1. An interactive record system for automatically organizing and indexing data obtained from a number of internal and external input sources, comprising:

means for organizing a set of data along at least one indexing dimension;

means for identifying specific data events from said set of data according to predetermined methods;

means for establishing an index of data objects associated with said specific data events;

means for displaying said index of data objects and specific data events along said indexing dimension; and

means for defining actuators for manipulating said data objects indexed with said specific data events.

2. The interactive record system of claim 1 in which said means for establishing an index of data objects includes marker means for individually marking said specific data events.

3. The interactive record system of claim 2 in which said marker means includes means for designating the location of data associated with said specific data events.

4. The interactive record system of claim 2 in which said marker means includes means for specifying the configuration of said actuators.

5. The interactive record system of claim 2 in which said marker means includes means for determining a symbolic representation to be displayed for said data objects.

6. The interactive record system of claim 2 in which said marker means includes means for designating the operation to be effected for a specific data event.

7. The interactive record system of claim 1 in which said means for defining actuators include means for bounding interactive areas on a display screen corresponding to locations along said indexing dimension.

8. The interactive record system of claim 7 in which said means for bounding includes means for operating said actuators in response to a touching of said interactive areas.

9. The interactive record system of claim 7 in which said means for bounding includes means for operating said actuators in response to a contacting of said interactive areas with a cursor.

10. The interactive record system of claim 1 in which said means for displaying includes means for generating descriptive pictorial icons which are symbolic representations of said data objects and said specific data events and which are associated with said specific data events along said indexing dimension.

11. The interactive record system of claim 1 in which said means for organizing includes an indexing dimension which is time.

12. The interactive record system of claim 1 in which said means for identifying specific data events includes means for comparing said set of data to a reference.

13. The interactive record system of claim 1 in which said means for identifying specific data events includes means for reviewing data objects to generate additional specific data events.

14. The interactive record system of claim 1 in which said means for organizing a set of data includes means for graphically plotting said set of data on a display screen.

15. The interactive record system of claim 14 in which said means for graphically plotting includes means for graphically displaying minimum, maximum and mean values of data over a given interval.

16. The interactive record system of claim 1 in which said means for establishing includes a data object comprising at least one of a plurality of data fields including audio, visual, textual, numerical, algorithmic and graphical data.

17. An interactive record system for automatically organizing and indexing data obtained from a number of internal and external input sources, comprising:

means for organizing a set of data relative to at least one indexing dimension;

means for identifying specific data events from said set of data according to predetermined methods;

means for plotting said specific data events on a display screen along an axis representative of said indexing dimension;

means for establishing an index of data objects from internal sources and external sources associated with said specific data events;

means for displaying said index of data objects and said specific data events relative to said specific data events; and

means for defining actuators associated with said specific data events for manipulating said data objects.

18. The interactive record system of claim 17 in which said means for establishing an index of data objects includes means for individually marking said specific data events.

19. The interactive record system of claim 18 in which said marker means includes means for designating the location of data associated with said specific data events.

20. The interactive record system of claim 18 in which said marker means includes means for specifying the configuration of said actuators.

21. The interactive record system of claim 18 in which said marker means includes means for determining a symbolic representation to be displayed for a data object.

22. The interactive record system of claim 18 in which said marker means includes means for designating the operation to be effected for a specific data event.

23. The interactive record system of claim 17 in which said means for identifying specific data events includes means for reviewing data objects to generate additional specific data events.

24. The interactive record system of claim 17 in which said means for defining actuators includes means for bounding interactive areas on a display screen corresponding to locations along said axis.

25. The interactive record system of claim 24 in which said means for bounding includes means for operating said actuators in response to a touching of said interactive areas.

26. The interactive record system of claim 24 in which said means for bounding includes means for operating said actuators in response to a touching of said interactive areas.

27. The interactive record system of claim 17 in which said means for displaying includes means for generating descriptive pictorial icons which are symbolic representations of said data objects and said specific data events and which are associated with said specific data events along said indexing dimension.

28. The interactive record system of claim 17 in which said means for establishing includes a data object comprising at least one of a plurality of data fields including audio, visual, textual, numerical, algorithmic and graphical data.

29. The interactive record system of claim 17 in which said means for displaying includes display control means for representing data on said axis in magnified and reduced format.

30. A medical interactive record system for automatically organizing and indexing data obtained from a number of patient monitoring source comprising:

means for organizing a set of monitored data relative to time;

means for determining desired values of data taken over a given interval of time;

means for representing said values on a display screen as linear trends relative to a point displayed on an axis representing time;

means for identifying specific data events from said trends that are greater than or less than predetermined threshold values;

means for establishing an index of data objects from automatic inputs, from internally generated data and from data input manually associated with said specific data events;

means for displaying said index of data objects associated with said specific data events using pictorial icons that symbolically represent said data objects;

means for defining actuators associated with said specific data events for manipulating said data objects;

means for operating said actuators in response to a touching by at least one of a cursor touch and a physical touch; and

means for accessing said data objects in response to a touching by at least one of a cursor touch and a physical touch.

31. The medical interactive record system of claim 30 in which said means for establishing includes a data object comprising at least one of a plurality of data fields including audio, visual, textual, numerical, algorithmic and graphical data.

32. The medical interactive record system of claim 30 in which said means for establishing includes means for signifying the type of data objects to be created for said specific data events.

33. The medical interactive record system of claim 30 in which said means for displaying includes display control means for representing data on said axis in magnified and reduced format.

34. A medical interactive record system for use in a cardiac catheterization laboratory for automatically organizing and indexing data obtained from a physiological monitor, comprising:

means for organizing a set of physiological data relative to time of input;

means for determining the high, low and means values taken over a given interval of time;

means for graphing said values on a display screen as vertical line trends relative to a point displayed on a horizontal axis representing time of input;

means for identifying specific physiological events from said trends that cross a predetermined threshold value;

means for establishing an index of data objects from physiological monitor data, internally generated data, automatically input data and data input by personnel, associated with said specific physiological events;

means for displaying said index of data objects relative to said specific physiological events using pictorial icons that symbolically represent said data objects;

means for creating actuators associated with said trends in order to manipulated said data objects;

means for operating said actuators in response to a touching by at least one of a cursor touch and a physical touch; and

means for accessing said data objects in response to a touching by at least one of a cursor touch and a physical touch.

* * * * *

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United States Patent [19]

McKiel, Jr.

[11] Patent Number: 5,287,102

[45] Date of Patent: Feb. 15, 1994

[54] METHOD AND SYSTEM FOR ENABLING A BLIND COMPUTER USER TO LOCATE ICONS IN A GRAPHICAL USER INTERFACE

[75] Inventor: Frank A. McKiel, Jr., Trophy Club, Tex.

[73] Assignee: International Business Machines Corporation, Armonk, N.Y.

[21] Appl. No.: 811,507

[22] Filed: Dec. 20, 1991

[51] Int. Cl.[5] G09B 21/00

[52] U.S. Cl. 340/825.19; 434/116; 345/163

[58] Field of Search 340/825.19, 709, 710, 340/711, 407; 434/112, 116, 117; 358/94; 341/21

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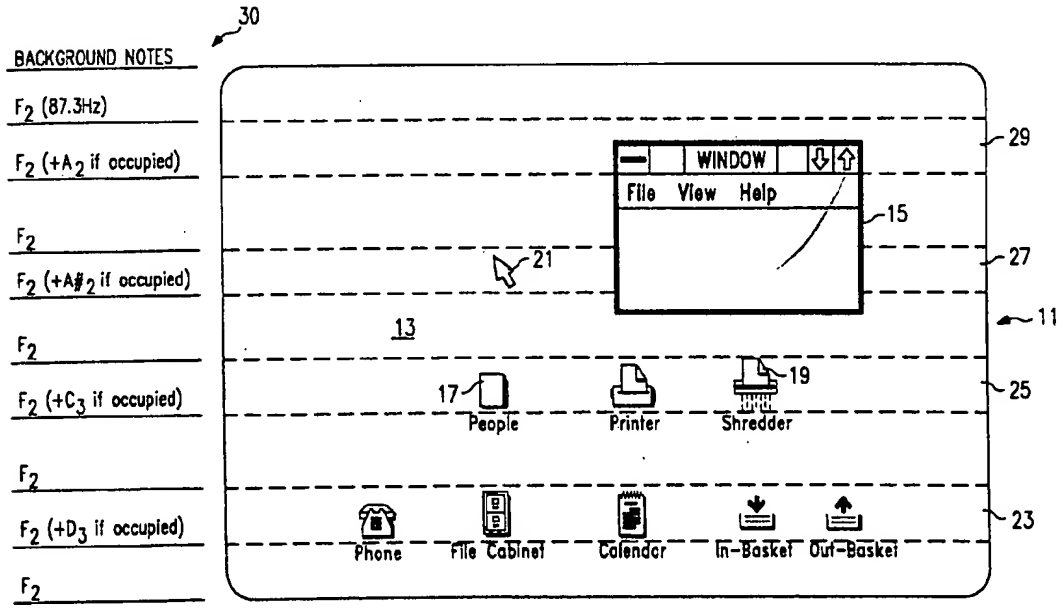
Primary Examiner—Donald J. Yusko
Assistant Examiner—John E. Giust
Attorney, Agent, or Firm—Jonathan E. Jobe, Jr.

[57] ABSTRACT

Disclosed is a computer audio interface adapted to enable blind or visually impaired users to locate icons positioned in rows in the background of a graphical user interface. Whenever the pointer of the interface is positioned on the background, the system produces a distinctive tone. Whenever the pointer is positioned in an icon row that is occupied by one or more icons, the system produces a distinctive chord. Whenever the pointer is positioned in the background and not in an occupied row, the system produces stereo effects that give the user information as to the relative left/right position of the pointer. Whenever the pointer is positioned in an occupied row, the amplitude of the left and right stereo channels is controlled such that whenever the pointer is to the left of the leftmost icon, substantially all of the volume is produced by the left speaker and whenever the pointer is to the right of the rightmost icon, substantially all of the the volume is produced by the right speaker. Whenever the pointer is located between the leftmost and rightmost icons, the volume is balanced substantially equally between the two speakers.

19 Claims, 3 Drawing Sheets



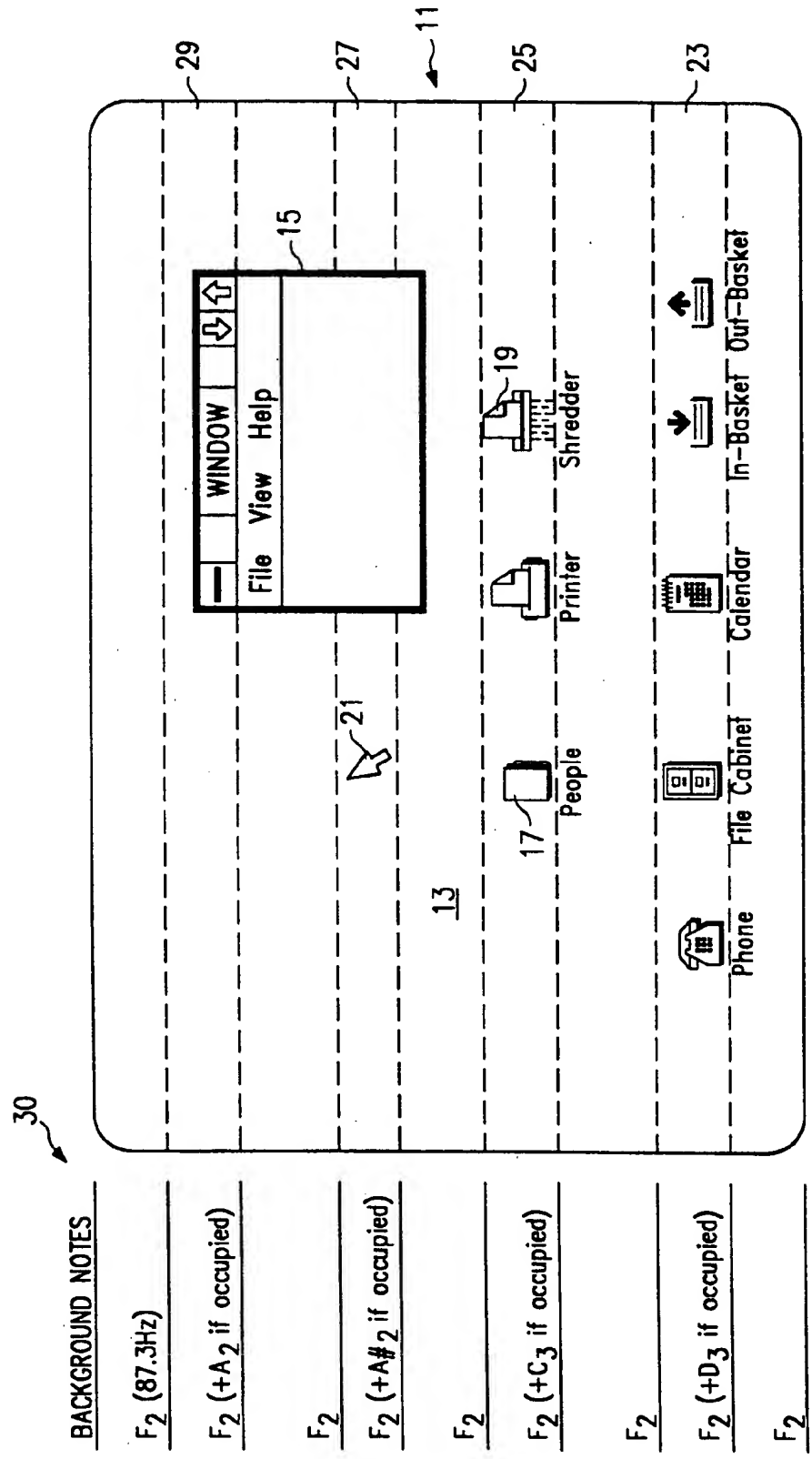

30
11
29
27
25
23
15
WINDOW
File View Help
19
Shredder
Printer
People
17
21
13
Phone
File Cabinet
Calendar
In-Basket
Out-Basket
BACKGROUND NOTES
F2 (87.3Hz)
F2 (+A2 if occupied)
F2
F2 (+A#2 if occupied)
F2
F2 (+C3 if occupied)
F2
F2 (+D3 if occupied)
F2

FIG. 1

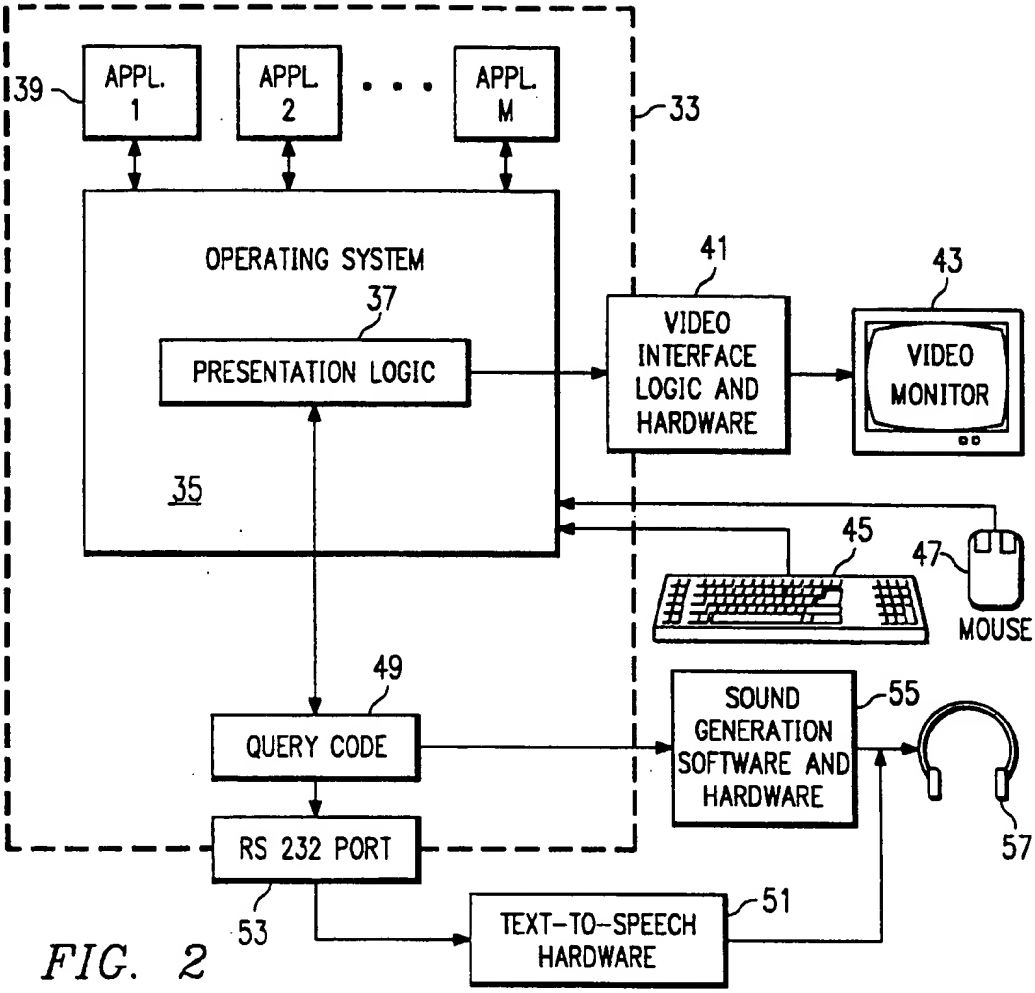

39
APPL. 1
APPL. 2
APPL. M
33
OPERATING SYSTEM
37
PRESENTATION LOGIC
35
41
VIDEO INTERFACE LOGIC AND HARDWARE
43
VIDEO MONITOR
45
47
MOUSE
49
QUERY CODE
RS 232 PORT
53
SOUND GENERATION SOFTWARE AND HARDWARE
55
57
TEXT-TO-SPEECH HARDWARE
51

FIG. 2

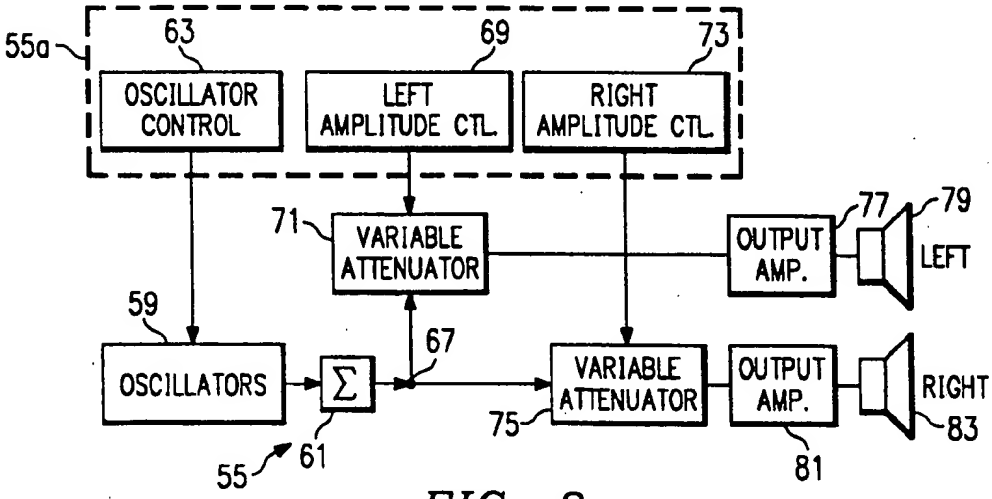
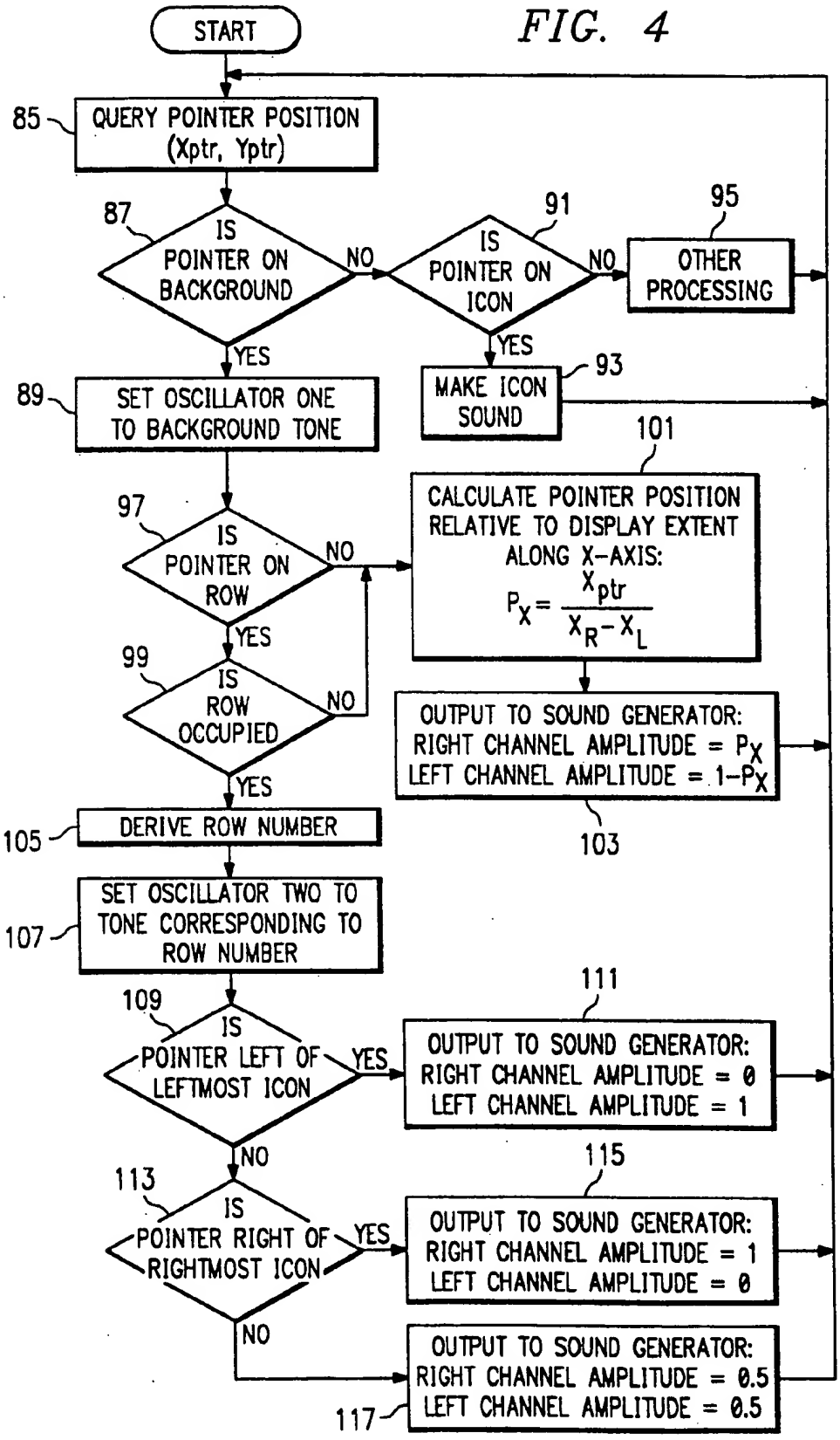

55a
63
OSCILLATOR CONTROL
69
LEFT AMPLITUDE CTL.
73
RIGHT AMPLITUDE CTL.
71
VARIABLE ATTENUATOR
77
OUTPUT AMP.
79
LEFT
59
OSCILLATORS
Σ
67
VARIABLE ATTENUATOR
75
OUTPUT AMP.
RIGHT
83
55
61
81

FIG. 3

FIG. 4



METHOD AND SYSTEM FOR ENABLING A BLIND COMPUTER USER TO LOCATE ICONS IN A GRAPHICAL USER INTERFACE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a system and method for enabling a blind or visually impaired user to use a graphical user interface, and more particularly, to a system and method for enabling a blind or visually impaired user to locate icons in a graphical user interface.

2. Description of the Prior Art

In recent years, there has been a move among computer application software developers toward graphical user interfaces (GUIS). In graphical user interfaces, objects are presented for users to manipulate in ways that are similar to the way that they are manipulated in the real work place. Objects, such as file cabinets, folders, documents, and printers, are displayed on the screen as icons. Users manipulate these objects with a mouse to perform desired operations. For example, to file a document in a folder that is located in a file cabinet in the real work place, the user opens the file cabinet, locates and opens the correct folder, and puts the document inside. In the electronic work place of the graphical user interface, the user performs a similar process. The user opens the file cabinet icon, locates the correct folder icon, and drops the document icon in the folder. Because this is an electronic environment, users do not have to open the folder to put the document in it. However, users have been able to use their knowledge of a real work place to perform this operation.

Normally sighted persons find graphical user interfaces intuitive and easy to work with. However, except for an occasional "beep" or "bong", graphical user interfaces are virtually silent and the vast majority of the information they provide to the user is visual. Thus, graphical user interfaces are essentially not usable by blind or severely visually impaired people.

Blind and visually impaired computer users now benefit from many forms of adaptive technology, including speech synthesis, large-print processing, braille desktop publishing, and voice recognition. However, presently, almost none of the foregoing tools is adapted for use with graphical user interfaces. It has been suggested that programmers could write software with built-in voice labels for icons. Lazzaro, *Windows of Vulnerability,* Byte Magazine, June, 1991 page 416. Various synthetic or recorded speech solutions for making computer display screen contents available to blind persons have been suggested, for example in Golding, et. al., IBM Technical Disclosure Bulletin, Vol. 26, No. 10B, pages 5633-5636 (March 1984), and Barnett, et. al., IBM Technical Disclosure Bulletin, Vol. 26, No. 10A, pages 4950-4951 (March 1984). Recently, there has been disclosed a prototype of a system called IBM Screen Reader/PM. Schwerdtfeger, *Making the GUI Talk,* Byte Magazine, December 1991, page 118. According to the Schwerdtfeger article, a user of the IBM Screen Reader/PM system can maneuver a mouse over the display and use the keyboard or a separate keypad, and a voice synthesizer will describe an icon the GUI has displayed or the graphical text shown on the screen. Additionally, there have been suggested systems that include a mouse with a braille transducer so that a blind user may read text and obtain certain tactile position feedback from the mouse. Comerford, IBM Technical Disclosure Bulletin Vol. 28, No. 3, page 1343 (August 1985), Affinito, et. al., IBM Technical Disclosure Bulletin Vol. 31, No. 12, page 386 (May 1989). However, while announcing various text items, either audibly or by means of a braille transducer in the mouse, may provide some information to blind user, it does not enable the user to navigate about and locate objects on the computer display screen.

There has been suggested an audible cursor positioning and pixel (picture element) status identification mechanism to help a user of an interactive computer graphics system locate data by using aural feedback to enhance visual feedback. As the cursor is stepped across the screen, an audible click is generated that varies in tone corresponding to the current status of each pixel encountered. With this combination in audible and visual cursor feedback, it becomes a simple task to identify the desired line by noting the change in tone as the cursor moves. For color display applications, each color is represented by a distinct tone so any single pixel may be distinguished from the surrounding pixels of a different color. Although the technique was originally developed for computer aided drafting, it has been suggested that this system is especially helpful for visually impaired or learning disabled users. Drumm, et. al., IBM Technical Disclosure Bulletin, Vol. 27, No. 48, page 2528 (September 1984). However, the foregoing disclosure does not suggest a means of enabling a blind user to navigate about or locate objects on the computer display screen.

Recently, in U.S. Pat. No. 5,223,828, issued Jun. 29, 1993, entitled "Method and System for Enabling a Blind Computer User to Handle Message Boxes in a Graphical User Interface", which is assigned to the assignee of the present application, a system has been proposed that permits a blind or visually impaired user to interact with message boxes within a graphical user interface. Each message box consists of an icon, explanatory text, and one or more "pushbuttons". The icon allows the user to identify visually the type of message. The text typically explains the situation and may provide assistance. The textual content may be a question or a statement. Pushbuttons provided within the message box typically allow the user to interact with the message box.

The system of U.S. Pat. No. 5,223,828 permits blind or visually impaired users to accommodate a message box by announcing the textual content of such a box when the message box first appears. Thereafter, the pushbuttons available to respond to the message box are announced in order from left to right. A homing signal was then provided for finding the message box. The homing signal increases in pitch as the mouse pointer approaches the message box. When the pointer enters the message box, the message box text and available pushbuttons are re-announced and the pointer is automatically moved to a default pushbutton. By using this system, a blind or visually impaired user may locate a message box within a computer system.

Another system and method is disclosed in U.S. patent application Ser. No. 08/022,788, filed Feb. 22, 1993, which is a continuation of abandoned U.S. patent application Ser. No. 07/746,840, filed Aug. 19, 1991, and entitled "Audio User Interface With Stereo and Filtered Sound Effects", which is assigned to the assignee of the present application. The system and method of application Ser. No. 07/746,840, permits a blind or visu-

ally impaired user to locate a mouse pointer or other graphical pointing device within the client area of a window within a graphical user interface by providing a stereo sound system and varying the intensity of the left and right audio channels to indicate the horizontal position of the mouse pointer. That system also proposes an increase in pitch of an associated sound to indicate the relative position of the pointer in the top/-bottom access of the client area of the window.

Recently, in application Ser. No. 07/802,956, filed Dec. 5, 1991, entitled "Method and System for Enabling Blind or Visually Impaired Computer Users to Graphically Select Displayed Elements", which is assigned to the assignee of the present application, there is disclosed a method and system that may be used to enable a blind or visually impaired computer user to graphically select a displayed graphic element within a computer system display. A unique identifiable audible signal is associated with each displayed graphic element. A moveable cursor element or a pointer is displayed within the computer system display and a composite audible signal is periodically generated in response to the position of the moveable cursor element. The composite audible signal preferably includes elements of each identifiable audible signal associated with each displayed graphic element within a pre-determined radius of the location of the moveable cursor element. In one embodiment of that system and method, each displayed graphic element comprises multiple picture elements and the composite audible signal includes elements of each identifiable audible signal associated with each displayed graphic element having picture elements within a rotational sector of a circle having its origin at the moveable cursor element and a radius equal to the pre-determined radius.

In certain graphical user interfaces, frequently used objects that have system wide application are positioned in the background of the display screen, which is frequently called the "electronic desktop." Such objects may include printer icons and wastebin or shredder icons. The printer icons are provided so that a user may print a document or other objects by direct manipulation and shredder or wastebin icons are provided so that the user can delete a document or object by direct manipulation. Those icons are positioned on the desktop so that they will be readily available to the user without the user having to open a window that may contain them. Users are also typically given the ability to customize their interfaces by placing various objects of their own choosing on their desktop. Certain operating systems adapted for graphical user interfaces, such as IBM OS/2 Presentation Manager, provide a facility that automatically arranges the icons on the desktop in rows.

The prior art has provided certain tools by which a blind or visually impaired user may navigate within windows and find certain elements. However, there does not currently exist any tool by which a blind or visually impaired user can readily locate icons on the desktop. In the prior work on audio graphical user interfaces, the blind user has been able to wander about the screen in search of icons. When passing over an icon, certain sounds have been created or altered along with a verbal announcement of the identity of the icon using a text-to-speech synthesizer. However, this random searching process can be tiresome and time consuming to the user.

SUMMARY OF THE INVENTION

The present invention provides a method and system that provides the user of the system with audio information regarding the position of the pointer on a display screen, wherein the screen has displayed thereon a background and at least one row of spaced apart icons. The system includes, in addition to a display screen, a pointing device for manually positioning a pointer on the screen, and left and right speakers. Generally, the system generates a first distinctive sound, which, in the preferred embodiment, is a tone, from at least one of the speakers whenever the pointer is located in the background. Whenever the pointer is located in an icon row of the background that is occupied by an icon, the system generates a second distinctive sound, which, in the preferred embodiment, is a chord made up of the background tone plus another tone that is distinctive of the particular icon row in which the pointer is located. Whenever the pointer is located in the background, but not in a row, the relative volume of the tone generated by the speakers is related to the relative right/left position of the pointer on the screen. Whenever the pointer is located in an occupied icon row, the distinctive chord is generated substantially only from the right speaker whenever the pointer is located to the right of the rightmost icon in the row. Conversely, whenever the pointer is located in an occupied row and positioned to the left of the leftmost icon in the row, the sound is generated substantially only from the left speaker. Finally, whenever the pointer is located in an occupied row, but between the leftmost and rightmost icons, the sounds generated from each speaker is substantially equal to that generated by the other. Also, whenever the pointer is located on an icon, the system generates a distinctive sound.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a pictorial view of a computer display screen with a plurality of rows of icons displayed thereon.

FIG. **2** is a block diagram of a preferred system of the present invention.

FIG. **3** is a block diagram of a preferred sound generator of the system of the present invention.

FIG. **4** is a flowchart showing a preferred software implementation of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and first to FIG. **1**, a computer display screen is designated generally by the numeral **11**. Display screen **11** has displayed thereon a background **13** with a plurality of objects displayed thereon. The objects displayed on background **13** include a window **15** and a plurality of labeled icons, including a "people" or address book icon **17** and a "shredder" icon **19**. Display screen **11** also has displayed thereon a pointer **21** that is moveable about the screen by means of a mouse (not shown in FIG. **1**). A user of the system can operate the mouse to move pointer **21** to open, move, copy, or otherwise manipulate objects displayed on screen **11**.

Background **13** is sometimes referred to as an "electronic desktop." Certain objects, such as the labeled icons of FIG. **1**, may reside on the user's desktop so that they are readily available to the user. Various operating systems, such as OS/2 Presentation Manager provide a

facility, which in the case of OS/2 Presentation Manager is referred to as the "Desktop Organizer", that arranges the icons on the desktop in rows. In FIG. 1, the rows into which the icons of the desktop may be organized are indicated by dashed lines, and they include, in FIG. 1, a first row 23, a second row 25, a third row 27, and a fourth row 29. The four rows of FIG. 1 are illustrative only, and the system may be adapted to create more or fewer rows than are illustrated in FIG. 1. It will be recognized, of course, that the dashed lines of FIG. 1 are for the purpose only of illustrating the present invention, and do not actually appear on display screen 11. In FIG. 1, rows 23 and 25 are occupied by icons, but rows 27 and 29 are empty or unoccupied. Nevertheless, rows 27 and 29 are available to receive icons of the desktop and those rows exist in the system.

In the present invention, audio information is provided to enable a blind or visually impaired user to locate the various rows and the icons in the rows. It will be recognized that normally sighted users may also find the present invention advantageous in operating a system with a graphical user interface. A chart 30 of background notes is located to the left of display screen 11. The background notes chart 30 is for purposes of illustration only, and does not actually appear when the invention is in use. In FIG. 1, whenever pointer 21 is located in background 13, as opposed to, for example, in window 15, or on one of the labeled icons, a background sound is produced. In the preferred embodiment, the background sound is a single tone, which for purposes of illustration, is an F_2 according to the American Standard pitch, adopted by the American Standards Association in 1936, which has a frequency of 87.31 Hertz. Whenever pointer 21 is located in background 13, the system produces the note F_2. If pointer 21 is located somewhere other than background 13, the system produces an appropriate sound effect. For example, if pointer 21 is located in window 15, the system produces the sound effects shown and described in U.S. patent application Ser. No. 07/746,840, filed Aug. 19, 1991. Similarly, if pointer 21 were positioned on shredder icon 19, the system would announce, by text-to-speech or recorded speech, "shredder".

Referring still to FIG. 1, whenever pointer 21 is positioned in an occupied row, the system produces, in addition to the background note F_2, an additional note that makes a distinctive chord that identifies each row. Whenever a row is not occupied, the system produces only the background note F_2 and not the additional note. Thus, since first row 23 is occupied, the system produces simultaneously the notes F_2 and D_3, which makes a chord. Similarly, since row 25 is occupied, the system produces the chord comprising the notes F_2 and C_3. Since third row 27 and fourth row 29 are unoccupied, the system produces only the note F_2. However, if rows 27 or 29 were occupied, then the appropriate chord would be produced as set forth in table 30 of background notes.

In the preferred embodiment of the invention, the system produces, in addition to tonal information with respect to the location of pointer 21, which is related generally to the vertical, or top/bottom position of pointer 21 in background 13, stereo information respecting the horizontal or left/right position of pointer 21 in background 13.

Accordingly, in the system of the preferred embodiment of the invention, a pair of laterally spaced apart stereo speakers are provided. The stereo speakers may take the form of normal audio speakers, or headphones, or the like. The system includes means, as will be described in detail hereinafter, for controlling the respective volumes of the speakers to achieve stereo effects.

In the preferred embodiment of the invention, whenever pointer 21 is positioned in background 13 and not in an occupied row, the respective volumes of the background tone produced by the speakers is related to the left/right position of pointer 21 on screen 11. However, whenever pointer 21 is in an occupied row, the stereo effect is altered such that whenever pointer 21 is to the left of the leftmost icon of the row, substantially all of the volume of the chord associated with the row is produced by the left speaker. Similarly, whenever pointer 21 is located to the right of the rightmost icon of the row, substantially all of the volume of the chord indicative of the row is produced by the right speaker. Whenever pointer 21 is located in a row between the leftmost and rightmost icons, but not on an icon, the volume is balanced equally between the left and right speakers.

Referring now to FIG. 2, there is shown a block diagram of the system of the present invention. The system includes CPU hardware, which is indicated generally by dashed block 33. Running on CPU hardware is an operating system 35, which includes presentation logic 37. Presentation logic 37 manages the presentation of text and graphic information on the computer display screen. A plurality of application programs 39 are shown running on operating system 35. The system includes video interface logic and hardware 41, which supplies video information to a video monitor 43.

The system includes a keyboard 45 and a mouse 47, which allow the user to input data and operate the system. The system also includes query code, which is designated generally by the numeral 49. As will be described in greater detail, query code 49 queries the system as to the current position of pointer 21. Query code 49 also provides text information to text-to-speech hardware 51 via RS232 port 53 and sound information to sound generation software and hardware, shown generally at block 55. The speech and sound information is provided to the user by speakers or headphones 57. Text-to-speech hardware 51 is commercially available.

Referring now to FIG. 3, there is shown a block diagram of the sound generation software and hardware 55 of the present invention. Sound generation hardware 55 includes at least two oscillators, which are designated by the numeral 59. Oscillators 59 include at least a first oscillator, which may be fixed or variable, that produces the background note, which in the preferred embodiment is F_2. Oscillators 59 also includes a variable second oscillator that may be controlled to produce the secondary notes that combine with background note F_2 to produce the distinctive chords for occupied rows. The tones produced by oscillators 59 are summed by a summing circuit 61.

The sound generation software includes outputs that are enclosed in dashed rectangle 55a. Sound generation software outputs include an oscillator control 63, which turns on and off the various oscillators 59 and controls the frequency of the various variable frequency oscillators of oscillators 59.

The output from summing circuit 61 is split at 67 into left and right channels. A left amplitude control 69 controls a variable attenuator 71 in the left channel and

a right amplitude control 73 controls a variable attenuator 75 in the right channel. The output from variable attenuator 71 is amplified by an output amplifier 77 and the audio signal is produced at left speaker 79. Similarly, the output from variable attenuator 75 is amplitude by an output amplifier 81 and produced as an audio signal at speaker 83.

Referring now to FIG. 4, there is shown a flowchart of a preferred embodiment of the query code of the present invention. First, the pointer position (Xptr, Yptr) is queried at block 85. Then, the system tests, at decision block 87, whether or not the pointer is positioned on the background. If, at decision block 87, the pointer is on the background, then, at block 89, the frequency of oscillator one is set to the background tone. If, on the other hand, the pointer is not on the background, the system tests at decision block 91 whether or not the pointer is on an icon; if it is, then, as generally indicated at block 93, the system produces the appropriate icon sound, which in the preferred embodiment is an announcement of the name of the icon by text-to-speech. After the system has made the icon sound at block 93, the system returns to block 85 to continue monitoring the position of the pointer. If, at decision block 91, the pointer is not on an icon, then the system performs other processing, indicated generally at block 95. For example, if the pointer is on a window, the system processes the pointer position according to application Ser. No. 07/746,840, filed Aug. 19, 1991.

Referring again to decision block 87, if the pointer is on the background and after oscillator one has been set to the background tone at block 89, the system tests at block 97 whether or not the pointer is on a row. If the pointer is on a row, then the system tests at decision block 99 whether or not the row is occupied. If, at decision block 97, the pointer is not on a row, or if, at decision block 99, the pointer is on an unoccupied row, the system calculates, at block 101, the pointer position relative to the display extent along the X axis by the formula:

$$Px = \frac{Xptr}{Xr - Xl}$$

Where: Xr is the X coordinate of the right edge of the background; and Xl is the X coordinate of the left edge of the background.

The denominator of the foregoing formula is basically the width of the display screen. Thus, Px is a number from zero to one that reflects the position of the pointer along the X or left/right axis of the display screen. After the system has calculated the relative pointer position at block 101, the system outputs the relative amplitudes of the right and left channels to the sound generator at block 103 and returns to continue monitoring pointer position at block 85.

If, at decision blocks 97 and 99, the pointer is on an occupied row, then the system, at block 105, derives the row number corresponding to the pointer's position. Then, at block 107, the system sets oscillator number two to the tone corresponding to the row number. Referring briefly to FIG. 1, if pointer 21 were in first row 23, oscillator two would be set to the tone D_3. The tones related to the various row numbers can be maintained in a look-up table.

After the system has set oscillator number two to the tone corresponding to the row number the system tests at decision block 109 whether the pointer is to the left of the leftmost icon. If it is, the system, at block 111 sets the amplitude of the right channel of the sound generator to zero and the amplitude to the left channel to one and returns to block 85 to continue monitoring pointer position. If, on the other hand, the pointer is not left at the leftmost icon, the system tests at decision block 113 whether or not the pointer is to the right of the rightmost icon. If it is, the system sets the amplitude to the right channel of the sound generator to one and the amplitude to the left channel to zero at block 115 and returns to block 85 to continue monitoring pointer position. If at decision blocks 109 and 113 the pointer is neither to the left of the leftmost icon nor to the right of the rightmost icon, the system sets the output to both the right and left channels of the sound generator to 0.5 at block 117 and returns to block 85 to continue monitoring pointer position.

In operation, a user can quickly run the pointer up or down the background and identify the number and location of the rows of icons on the desktop. The chords produced when the pointer is on a row are distinctive and easily recognized by the user. After the user has located the rows, the user can quickly scan each row to find the appropriate icon. If the user hears the chord from the right speaker, the user knows that all of the icons in the row are toward the left. The user can move the pointer toward the left and hear the announcement of each icon in the row. When the pointer is between the leftmost and rightmost icons the sound is balanced between the two speakers. Thus, the user knows that there are icons both to the left and right of the pointer. After the user has moved the pointer to the left beyond the leftmost icon of the row, the balance of the chord shifts to the left speaker, thereby informing the user that there are no more icons in the row. If the user moves the pointer back toward the right, the balance will shift to the middle and then to the right. Of course, if there is only one icon in a row, the balance will be either all from the right or all from the left depending on whether the pointer is to the right or left of the single icon.

From the foregoing, it may be seen that the system and method of the present invention provides a blind or visually impaired user with audio information sufficient to enable the user to locate quickly and easily icons displayed in rows on the background of a graphical user interface. The present invention may also find use among normally sighted users who desire additional sensory input. While the invention has been particularly shown and described with reference to a preferred embodiment, those skilled in the art will understand that various changes may be made in form and detail without departing from the spirit and scope of the invention.

What is claimed is:

1. A method of providing the user of a computer system, including a display screen, a pointing device for manually positioning a pointer on said screen, a left speaker, and a right speaker, with audio information regarding the position of said pointer on said screen, wherein said screen has displayed thereon a background and at least one row of spaced apart icons, said method comprising the steps of:

generating a first sound from at least one of said speakers whenever said pointer is located on said background; and

generating a second sound from at least one of said speakers whenever said pointer is located on said row.

2. The method as claimed in claim 1, wherein said first sound is a first tone.

3. The method as claimed in claim 2, wherein said second sound is a chord.

4. The method as claimed in claim 3, wherein said chord includes said first tone and a second tone.

5. The method as claimed in claim 1, wherein the relative volume of said first sound generated by said speakers is related to the relative horizontal position of said pointer on said screen.

6. The method as claimed in claim 1, wherein said row of icons is oriented horizontally on said screen and said second sound is generated substantially only from said right speaker whenever said pointer is located on said row and to the right of the rightmost icon in said row.

7. The method as claimed in claim 6, wherein said second sound is generated substantially only from said left speaker whenever said pointer is located on said row and to the left of the leftmost icon in said row.

8. The method as claimed in claim 7, wherein said second sound is generated from each of said speakers at substantially equal volume whenever said pointer is located on said row and between the leftmost and rightmost icons.

9. The method as claimed in claim 1, including the step of generating a distinctive sound whenever said pointer is located on an icon.

10. The method as claimed in claim 1, wherein more than one row of icons is displayed on said screen and including the step of generating a different sound for each of said rows.

11. Apparatus for providing the user of a computer system, including a display screen and a pointing device for manually positioning a pointer on said screen, with audio information regarding the position of said pointer on said screen, wherein said screen has displayed thereon a background and at least one row of spaced apart icons, said apparatus comprising:

a left speaker and a right speaker;

means for generating a first sound from at least one of said speakers whenever said pointer is located on said background; and

means for generating a second sound from at least one of said speakers whenever said pointer is located on said row.

12. The apparatus as claimed in claim 11, wherein said means for generating said first sound includes means for generating a first tone.

13. The apparatus as claimed in claim 12, wherein said means for generating said second sound includes means for generating a chord.

14. The apparatus as claimed in claim 13, wherein said chord includes said first tone and a second tone.

15. The apparatus as claimed in claim 11, including means for controlling the relative volume of said first sound generated by said speakers relative to the horizontal position of said pointer on said screen.

16. The apparatus as claimed in claim 11, wherein said row of icons is oriented horizontally on said screen and said second sound is generated substantially only from said right speaker whenever said pointer is located on said row and to the right of the rightmost icon in said row.

17. The apparatus as claimed in claim 16, wherein said second sound is generated substantially only from said left speaker whenever said pointer is located on said row and to the left of the leftmost icon in said row.

18. The apparatus as claimed in claim 17, wherein said second sound is generated from each of said speakers at substantially equal volume whenever said pointer is located on said row and between the leftmost and rightmost icons.

19. The apparatus as claimed in claim 11, including, means for generating a distinctive sound whenever said point is located on an icon.

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